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M. Lev

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JOURNAL OF GERONTOLOGY

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AGING CHANGES IN THE HUMAN SINOATRIAL NODE

MAURICE LEV, M. D.

(From the Research Laboratories of the Mount Sinai Hospital of Greater Miami, Miami Beach, and the Department of Pathology, University of Illinois College of Medicine, Chicago)

NEONATAL aging changes in the human sinoatrial node have to date not been studied. The present report is rendered in order to make possible evaluation of pathologic findings in this structure. A method for the histopathologic study of this structure has previously been described (6).

MATERIALS AND METHODS

The sinoatrial node of 53 formalin-fixed hearts of various ages (table 1) was studied. These hearts exhibited no clinical or pathologic evidence of heart disease, with the exception of the usual aging changes in the valves. Eighteen were cut in longitudinal and transverse directions before a definite method of sectioning had been devised; 35 were sectioned in a manner previously described (6). Thirty-nine (from both groups) were stained with hematoxylin-eosin and Weigert-van Gieson stains; 14 were stained in addition with Gomori's trichrome, Mallory's phosphotungstic acid hematoxylin, and Hortega's reticulum stains.

TABLE 1. SINOATRIAL NODES STUDIED ACCORDING TO AGE GROUP

Age	Number Studied
4 - 9 Months Gestation.	3
Birth to 10 Years	5
11 - 20 Years	3
21 - 30 Years	4
31 - 40 Years	6
41 - 50 Years	7
51 - 60 Years	14
61 - 70 Years	8
71 - 90 Years	3
Total	53

RESULTS

At 4 months' gestation, the sinoatrial node consists of short muscle fibers arranged in a slightly plexiform arrangement, with a tendency towards longitudinal orientation (fig. 1). These cells are more loosely arranged than those of the surrounding atrium. In the midst of this node there is an artery, around which the muscle cells of the node serpiginously congregate (fig. 2). The nuclei of the fibers are oval with a transverse diameter which is equal to the transverse diameter of the cell. The chromatin material is spider-like. The sarcoplasm is scant with few myofibrils, no striations and no intercalated discs. There is a moderate number of fibroblasts, with a fine sprinkling of collagen fibers but no elastic fibers. The reticular network consists of a fine mesh of delicate fibrils. Some muscle fibers are of greater diameter, with larger nuclei and clearer staining cytoplasm. These fibers resemble Purkinje cells.

Comparison of the sinoatrial node with the atrial musculature reveals the following (figs.

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This investigation was supported by a grant from the Heart Association of Greater Miami and by a grant (H-430-C_2) from the National Heart Institute of the National Institutes of Health, United States Public Health Service.

Presented at the Sixth Annual Scientific Meeting of the Gerontological Society, Inc., August 25-27, 1953, San Francisco.

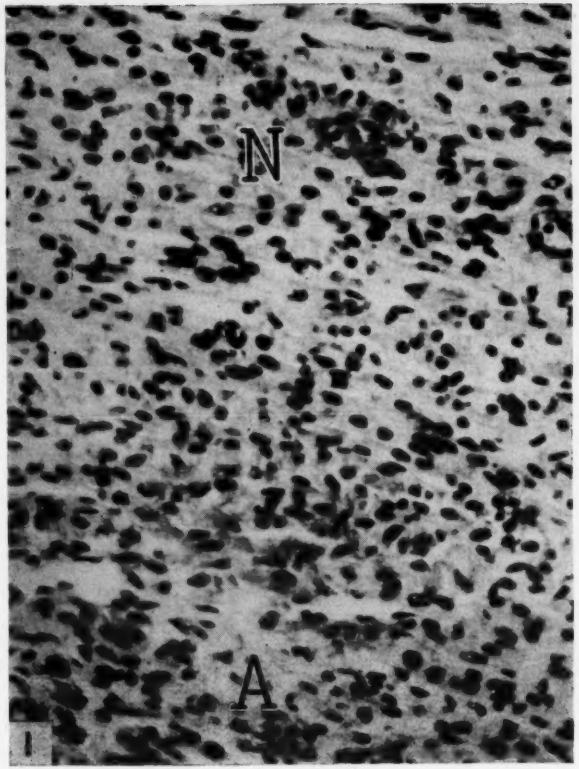


FIG. 1. Sinoatrial node and adjacent atrium at 4 months' gestation. Longitudinal section. Hematoxylin-eosin stain, X385.
N—S-A node.
A—Atrium.

FIG. 2. Sinoatrial node and adjacent atrium at 5 months' gestation. Transverse section. Hematoxylin-eosin stain, X210.
N—S-A node.
A—Atrium.

1 and 2) : There is a definite dirth of myofibrils in the node as compared to the atrial musculature, and distinct striations are already in evidence in the latter. There is no obvious difference in the diameter of the nuclei. There is an increased number of nuclei per field in the node, which is due to the greater abundance of fibroblasts and perhaps to a shortness of the fibers. There is a distinctly greater number of collagen fibers in the node. The reticular mesh is finer, and the fibers are slightly more delicate in the sinoatrial node.

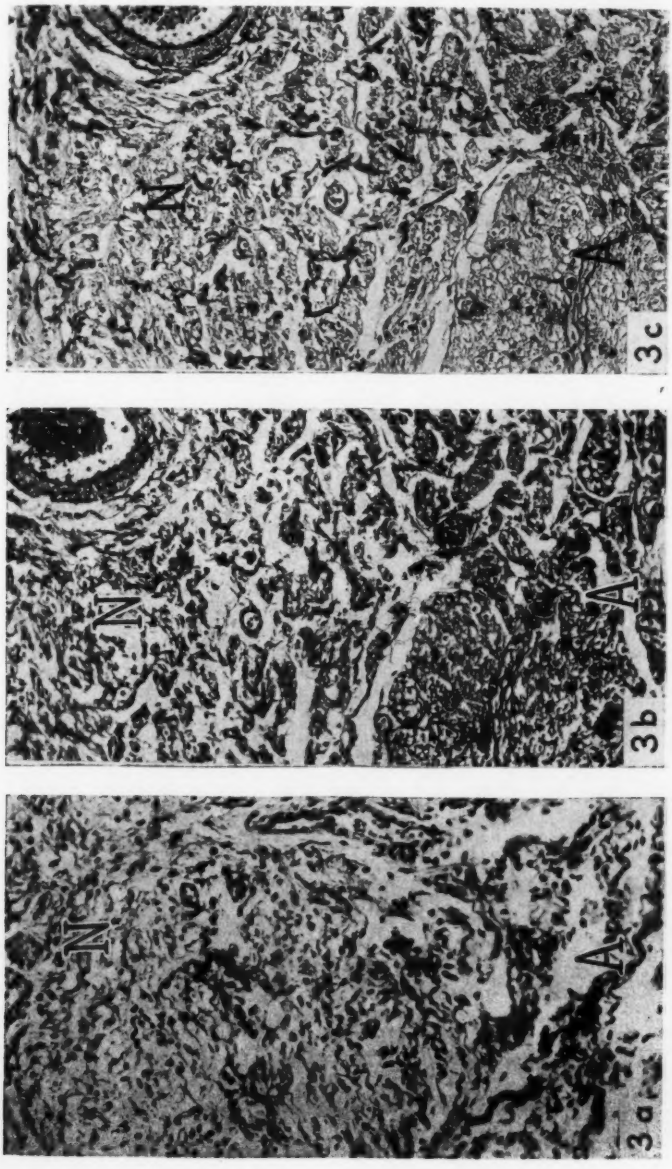


FIG. 3. Sinoatrial node and adjacent atrium at 9 months' gestation.
(a) Longitudinal section, Hematoxylin-eosin stain, X210. (b) Transverse section. Phosphotungstic acid hematoxylin stain, X187. (c) Transverse section. Weigert-van Gieson stain, X187.
N—S-A node.
A—Atrium.

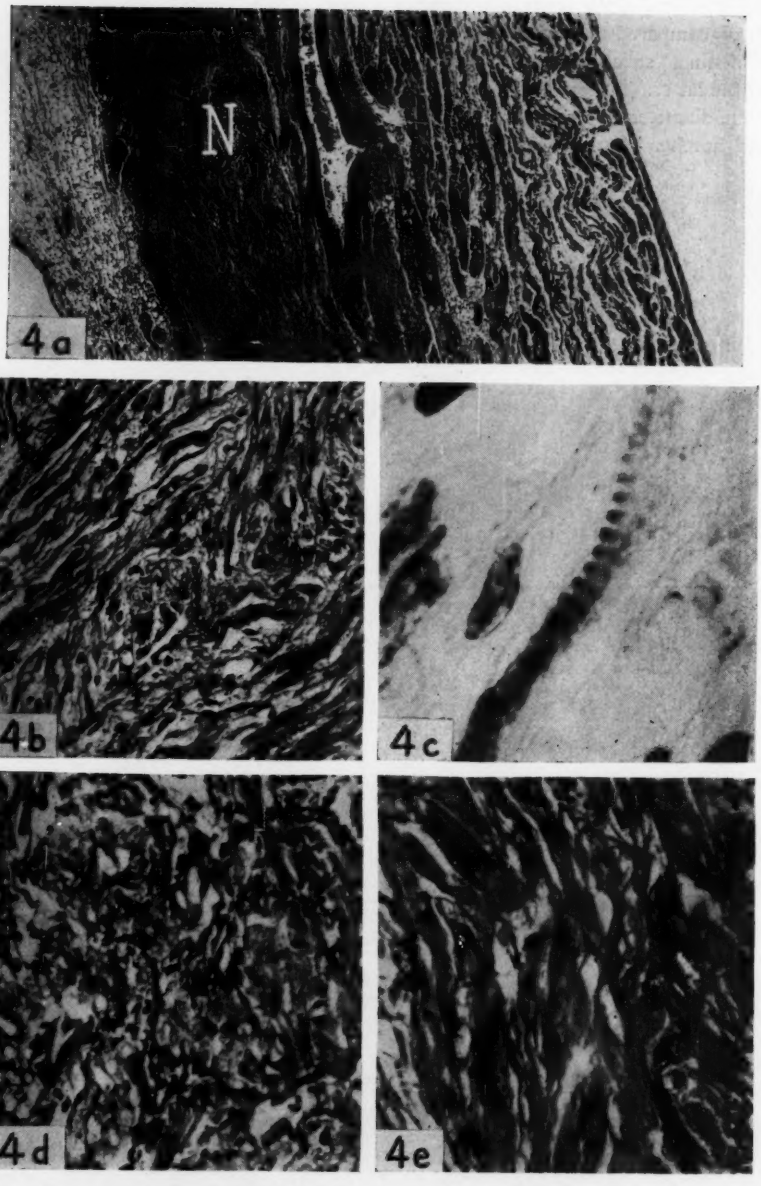


FIG. 4. Sinoatrial node at 20 years of age.
(a) Longitudinal section. Hematoxylin-eosin stain, X23.
(b) Longitudinal section. Hematoxylin-eosin stain, X210.
(c) Section shows transverse striations. Gomori's trichrome stain, X630.
(d) Transverse section. Weigert-van Gieson stain, X385.
(e) Longitudinal section. Weigert-van Gieson stain, X385.

At 5 months' gestation, elastic fibers appear in the node and are more prominent and copious than those in the atrial musculature. Occasional fine irregularly distributed striations also make their appearance at this age.

At birth, the muscle fibers of the node are slightly more elongated but they remain as slender as previously. The nuclei are of lesser diameter than previously but more elongated, assuming a fusiform appearance in some cases

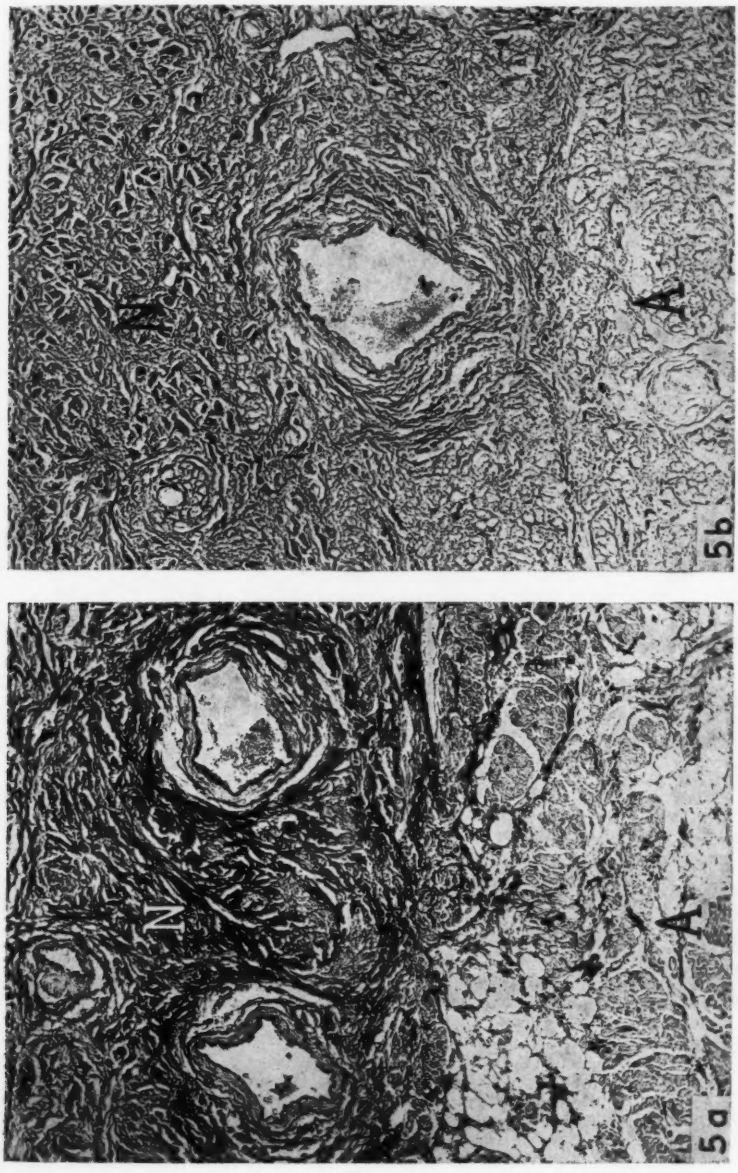
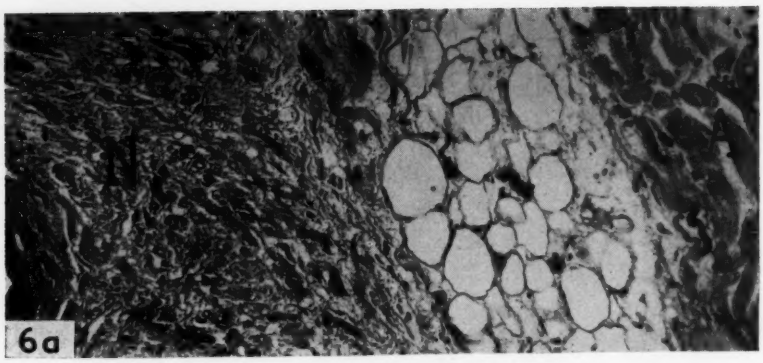
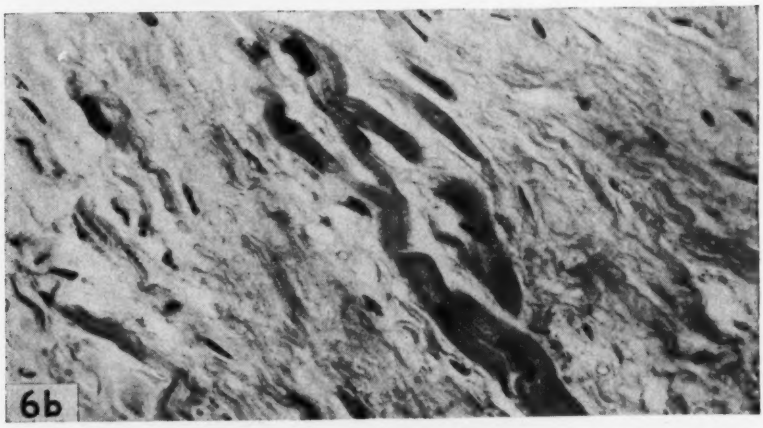


FIG. 5. Sinoatrial node at 40 years of age.
(a) Transverse section. Weigert-van Gieson stain, X102.
(b) Transverse section. Hortega's reticulum stain, X57.
N—S-A node.
A—Atrium.





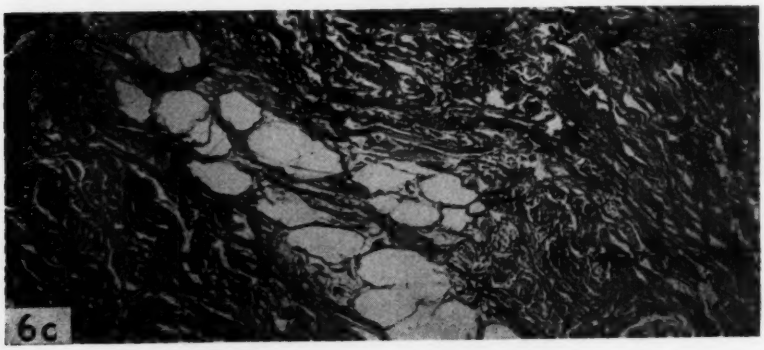


FIG. 6. Sinoatrial node at 65 years of age.
(a) Transverse section. Hematoxylin-eosin stain, X175.
(b) Section showing hypertrophied muscle fibers. Hematoxylin-eosin stain, X320.
(c) Section showing infiltration of fat and irregularity in thickness of elastic fibers. Weigert-van Gieson stain, X175.

(fig. 3a). The myofibrils have slightly increased in number (fig. 3b) and the striations are now more frequently seen. The collagen fibers have greatly increased in number, producing a more lobulated appearance of the entire structure (fig. 3c). As compared with the atrial musculature, the sinoatrial muscle fibers and their nuclei are shorter and more slender. By 1 to 2 years of age, this becomes still more evident, so that the differential characteristics of this structure are definitely established at this age. At about 5 years of age, fat cells become evident around the nodal tissue.

By 20 years of age, the muscle fibers of the node show a slight increase in length but very little increase in diameter. The nuclei are likewise longer, but more slender than previously (figs. 4a and 4b). Some of them now have square ends, others are cigar-shaped, and still others fusiform. The myofibrils are more numerous than previously, and the striations are distinct (fig. 4c). The collagen and elastic fibers have increased moderately (figs. 4d and 4e) and the reticular fibers are more distinct. It is now evident that the elastic fibers are mostly longitudinal, while the collagen fibers run in all directions. Comparison with the atrial musculature reveals that there is now a very obvious difference in diameter and length between the nodal and atrial fibers, the former being smaller (fig. 4a). The nuclei are only slightly less in diameter, however, so that the difference lies in the sarcoplasm and the myofibrils. The reticular network remains finer in mesh and in individual fibers than those of the atrial musculature. Fat is now frequently seen in the periphery of the node. Fibroblasts remain numerous in the node in contrast to the atrium.

By 30 years of age, fat begins to infiltrate into the node. There is now a diminution in fibrocytes and fibroblasts. There is no further increase in size of the muscle fibers. The collagen and elastic fibers are still more prominent than previously.

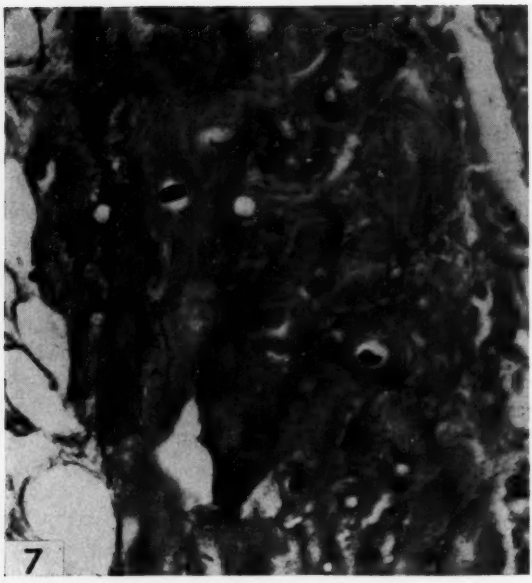
By 40 years of age, elastic and collagen fibers have become so abundant that they equal the number of muscle fibers (fig. 5a). Thus we now have irregularly alternating areas of muscle tissue and collagenous tissue. Each muscle fiber is surrounded by an elastic network, which has now taken on transverse in addition to longitudinal components. In addition, there is some variation in the thickness of the elastic fibers. Each muscle fiber likewise has a distinct reticular "basement membrane," resulting in a change of pattern from that seen at birth (fig. 5b). Fat is now frequently seen infiltrating the node. Since the total size of the node has not changed since the age of 20, there therefore seems to be a loss of muscle cells. Occasional larger muscle fibers with larger nuclei begin to become evident.

At 50, the node often appears outlined by fat tissue with only strips of muscular connections with the atrial myocardium and the interatrial band. The collagen is not appreciably increased. The elastic fibers however, continue to increase in thickness and in branching formations. Large muscle fibers with relatively large nuclei are now commonly seen.

By 60 years of age, the inequality in size and the irregularity in distribution of the muscle fibess of the sinoatrial node are very apparent (figs. 6a and 6b). Likewise the elastic fibers show a still greater abundance with inequality of staining (fig. 6c). The collagen however, again is not appreciably increased. The basement membranes around the muscle fibers are still more accentuated. After 60 years of age, there are no further changes noted.

Discussion

The above findings reveal that the sinoatrial node has certain characteristics which differentiate it from the atrial musculature: 1) the muscle fibers of the node after birth are smaller in diameter and length and they are arranged in a plexiform manner; 2) the nuclei after 2 years of age are less in diameter than those of the atrial musculature; 3) the muscle fibers have a lesser number of myofibrils with less prominent striations; 4) intercalated discs are not found; 5) the reticular network has a finer mesh consisting of more delicate fibrils;



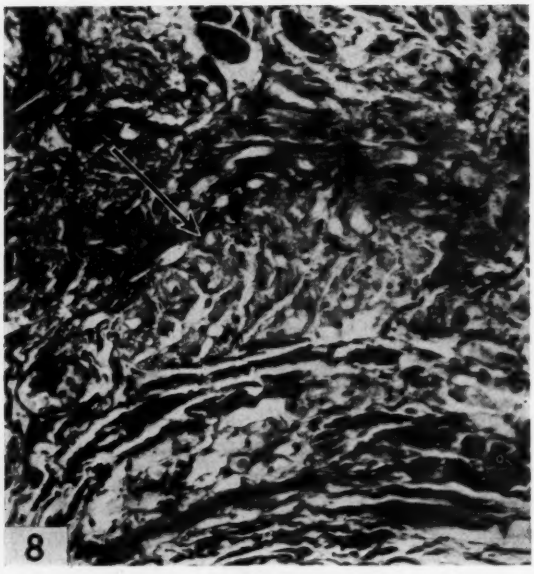


FIG. 7. Section showing Purkinje-like cells in Wenckebach's bundle. Hematoxylin-eosin stain, X320.

FIG. 8. Section showing nerve fiber in midst of bundle. Weigert-van Gieson stain, X320. Arrow points to the nerve fiber.

6) the collagen and elastic fibers are more numerous.

In our previous communication (6) we pointed out that the node makes connection with the atrial and superior vena caval musculature without the intervention of Purkinje fibers. Large fibers bearing some resemblance to Purkinje fibers may however be seen in the vicinity, especially in the intercaval band (fig. 7). Nerve fibers are found in the vicinity of, and in the substance of the head of the node (fig. 8).

The above findings confirm and extend the observations of Keith and Flack (4), MacKenzie (7), Koch (5), Burian (2), Blair and Davies (1), Nonidez (8), and Stotlar and Mahan (9). They are contrary to the views of Tandler (10), as concerns striations, Walmseley (13), as concerns nodal connections with the atrial musculature, and Taussig (11), as concerns the intervention of Purkinje fibers.

With advancing age the following changes occur: 1) the node grows more slowly than the atrial musculature; 2) there is an increase in collagen up to about 40, and a minimum increase thereafter; 3) there is an increase in elastic fibers throughout life; 4) there is an increase in reticular fibers with an accentuation of the individual fibers; 5) there is an apparent loss of muscle fibers after 40, with focal hypertrophy of individual fibers and focal thickening of the elastic and reticular nets; 6) there is an infiltration of fat about and in the node.

These findings lend evidence to the opinion that the sinoatrial node has individuality and histologic specificity, contrary to the opinions of Todd(12), and Glomset and Glomset (3).

Summary

A study is made of the human sinoatrial node in all age groups. This reveals that the structure is histologically specific and demonstrates growth characteristics different from those of the atrial musculature.

Acknowledgement is made to Mr. John T. Thomas for his technical assistance.

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THE RATE OF RESPIRATION AND GLYCOLYSIS BY HUMAN AND DOG AORTIC TISSUE[1]

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THE number of publications dealing with the metabolism of arterial tissue is comparatively small. The reason for the scarcity of investigations in this field must probably be sought in the previous lack of a sensitive procedure for measuring oxygen consumption by slowly respiring tissues. The recent development in this laboratory of accurate methods (13, 15) for determining the respiration of such tissues has overcome this obstacle. Because of the possibility that a relation may exist between changes in arterial metabolism and the development of arteriosclerosis, comprehensive studies in this field seem indicated.

The first determinations of respiration by intact arterial tissue from animals were carried out in 1938 by Michelazzi (18), who measured the oxygen uptake by 5 samples of aortas from adult rabbits. The determinations were made by the direct Warburg method on tissue suspended in Ringer's solution. The observed Q_{O_2} values ranged between 0.60 and 1.49 (mean 1.14). Similar studies on the oxygen consumption by rabbit aortas were later reported by Costa, Weber, and Antonini (9). The respiration measurements in this latter investigation were made by the procedure of Dickens and Simer; the medium used was Krebs' phosphate buffer (pH 7.3) with a glucose content of 0.2 per cent. Experiments were carried out on samples of the thoracic aorta from 5 newborn rabbits and 7 adult animals. A marked difference in respiratory rate was noticed between the 2 sets of samples. Thus the Q_{O_2} of the aortic tissue from the newborn rabbits was consistently found to be above 2.0, whereas the Q_{O_2} values of the adult rabbit aortas ranged between 0.62 and 0.93 (mean 0.76). Determinations of the respiratory quotient of the aortic tissue showed values between 0.80 and 1.00.

Extensive studies on oxygen consumption by rat aortic tissue were reported in 1949 by Briggs, Chernick, and Chaikoff (6). The determinations were made by the direct Warburg method on samples suspended in Krebs' phosphate buffer (pH 7.4) with a glucose content of 0.2 per cent. The investigation included 17 aortas from young rats, aged 1 to 2 months, and 24 aortas from adult rats, aged 14 to 18 months. No significant difference in oxygen uptake was noted between the 2 groups of samples, the average Q_{O_2} value for the young group being 1.06 (s. d. 0.14) and for the adult group 1.09 (s. d. 0.19).

A study of the respiratory rate of the aorta and the femoral artery of dogs was recently published by Hiertonn (11), who investigated the Q_{O_2} of arterial segments a few hours after sacrifice of the animals and after storage of the samples in a modified Tyrode's solution at 1 to 4 C. for periods of days or weeks. The Tyrode solution used contained 0.1 per cent of glucose and 10 per cent of dog serum and had a pH of 7.4. Phenol in a concentration of 0.04 mg./ml. and penicillin (1000 units/ml.) were added as preservatives. The oxygen consumption was determined by the direct method of Warburg; the lowest Q_{O_2} measurable by this method for the arterial tissue was found to be 0.10. Measurements on 6 fresh aortas and on 4 femoral arteries revealed average Q_{O_2} values of 0.24 and 0.31, respectively. Nearly 80 per cent of the samples still showed Q_{O_2} values above 0.10 after ten days of storage, and about 50 per cent continued to consume oxygen after having been maintained for three to four weeks in the medium.

The rate of glycolysis by arterial tissue has

[1] Studies on Arterial Metabolism III. A preliminary report of this study was given at the 44th Annual Meeting of the American Society of Biological Chemists, Chicago, April 6-10, 1953 (*Fed. Proc., 12:* 231, 1953). The investigation was supported by a grant (PHS-891) from the National Heart Institute of the National Institutes of Health, Public Health Service.
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been studied only by Michelazzi (18) and Südhof (24). The investigations by Michelazzi included measurements of the aerobic glycolysis by 3 samples of rabbit aortas. The determinations, which were carried out by the manometric Warburg procedure, showed Q_g^{o2} values of 1.63, 1.92, and 1.56.

Südhof measured the lactic acid production by segments of the carotid artery from cattle. The samples were suspended in Sawasaki's solution, which had a glucose content of 0.4 per cent. The experiments were performed both under aerobic and anaerobic conditions; the produced lactic acid was determined by the method of Lehnartz. A calculation of the glycolysis rates from the data in Südhof's protocols reveals values for the aerobic glycolysis (Q_g^{o2}) in 2 experiments of 0.300 and 0.330, and values for the anaerobic glycolysis (Q_g^{n2}) ranging in 4 experiments between 0.590 and 0.830.

As will be seen from the above summary, no studies on human arterial tissue have as yet been reported. The present investigation was undertaken with the purpose of supplying data on the respiratory rate and rates of aerobic and anaerobic glycolysis by human aortic samples contained under sterile conditions. For comparative purposes the study was supplemented with a series of similar measurements on dog aortas.

Methods

1. Acquisition and Preparation of Samples. —Samples of human aortas were obtained at the St. Louis City Morgue[1] and the Department of Pathology of the St. Louis City Hospital[1]. Sterile gloves and instruments were employed during the autopsies. After removal of the sternum and the anterior part of the left ribs the left lung was dislodged forward and to the right. This served to expose the thoracic aorta, which was then clamped off at the junction with the arch and at the level of the diaphragm and freed by blunt dissection. The severed, closed segment of the vessel was immediately placed in a sterile beaker immersed in crushed ice and transported to the laboratory.

For procurement of dog aortas[2] the animals were killed by intravenous administration of ether and air and the thoracic aorta removed under sterile conditions as described for the human samples.

The instruments, buffer medium, and all glassware used in the experiments were sterilized by autoclaving. The glucose solution used was a sterile, pure commercial preparation.

In preparation of both the human and dog aortas the adventitia was stripped off with sterile instruments. One part of the preparation, consisting of the intima and the media, was set aside for determination of dry matter and, in experiments on human samples, another for histologic examination. The remaining portion of the aorta was quickly weighed and appropriate samples used for respiration and glycolysis studies. The average wet weights of the tissue samples employed for a metabolic experiment were 3.72, 0.93, and 7.00 Gm., respectively, for the intact intima-media, the isolated intima, and the isolated media of the human aortas. The mean weight of the intima-media segments of the dog aortas was 1.17 Gm.

A modified Krebs' phosphate buffer was used in all experiments. The buffer contained 6.663 Gm. sodium chloride, 0.726 Gm. potassium chloride, 0.148 Gm. monobasic potassium phosphate, 1.338 Gm. dibasic sodium phosphate, 0.214 Gm. calcium chloride, 0.165 Gm. magnesium sulfate, and 2.0 Gm. glucose per liter. The pH was adjusted to 7.1 with hydrochloric acid. The calcium chloride, magnesium sulfate, and glucose were added to the buffer immediately before use. The osmolarity of the prepared medium was 0.33; it was checked by freezing point determination (—0.57 C.).

The buffer was chosen because it had been found in other experiments that rat diaphragms would retain their contractibility to electric stimulation after having been suspended in this medium for three hours at 37 C. The comparatively high concentrations of potassium (10.84

[1] The authors are indebted to Dr. J. J. Connor and Dr. J. A. Saxton, Jr. for assistance in obtaining specimens.

[2] The authors are indebted to the Department of Experimental Surgery, Washington University, for making dogs available for procurement of aortic samples.

mM/L.) and calcium (1.93 mM/L.) were used to prevent significant swelling of the tissue (1).

In the present study the weight change of the aortic samples, which occurred as the result of exposing the samples to the buffer medium, was measured by determination of the wet weight of the samples after the experiments. These measurements in many instances were made after the samples had been maintained in the medium for periods up to several weeks. It was found in experiments on 68 human aortic samples that 42 of the samples increased in weight (mean increase 6.4 per cent), whereas 26 samples decreased in weight (mean decrease 6.0 per cent). Similarly, out of 18 dog aortic samples examined, 13 increased in weight (mean increase 11.7 per cent), and 5 decreased (mean decrease 11.4 per cent). The comparatively small change noted in the mean weight of the samples suggests that the weight variations observed for individual aortic samples may have been caused, at least partly, by variations in the amount of water adhering to the surface of the tissue.

The ability of the buffer medium to prevent significant tissue damage was ascertained (2) by carrying out determinations of the nitrogen content (8) of the medium at various intervals during the experiments. In initial investigations under aerobic conditions on 4 human aortic samples an average increase in nitrogen of only 0.009 mg./ml. medium/hour/Gm. fresh tissue was found both during the first and second three hour periods after the rinsed tissue samples had been suspended in the medium. In similar studies on 4 other samples under anaerobic conditions, the mean increase in nitrogen valued 0.005 mg./ml. medium/hour/Gm. fresh tissue during the first three hour period, and 0.001 mg./ml. medium/hour/Gm. fresh tissue during the successive three hour period. The average ratio between weight of tissue and volume of medium in these experiments was 1:11.2.

The medium before use was heated to 42 C. and aerated with oxygen or nitrogen as described by Kirk and From Hansen (13); the temperature during the aeration decreased to 37 C. The aortic segment was then placed in the barrel of a 50 or 100 ml. glass syringe, closed by a metal stopcock (13). Blood adhering to the tissue surface was removed by rinsing the preparation placed in the syringe barrel with successive 2 ml. portions of the medium. To the aortic sample in the syringe barrel were then added 30 to 80 ml. of the warm medium, the plunger was inserted, and any free gas ejected. The metal stopcock was closed, and the exposed part of the plunger and upper part of the barrel wrapped with sterile plastic surgical drape. The syringe was then placed in the thermostat at 37 C., and rotation along its axis started. Twenty to 30 minutes were allowed for establishment of temperature and diffusion equilibrium before withdrawal of the first sample for analysis. The time from death to the start of the first experimental period varied between 2¼ and 32 hours for the human samples and between 1¼ and 5 hours for the dog samples.

For continuation of the studies on later dates the syringe, at the conclusion of the day's experiment, was placed in a refrigerator at 4 C. In the aerobic experiments sterile air was drawn into the syringe, whereas in the anaerobic studies anaerobiosis was maintained in the interval between tests. When the samples were again used for respiration and glycolysis studies the tissue was transferred to fresh buffer medium in another syringe.

The maintenance of sterility throughout the experiments was controlled by making cultures from the syringe content on aerobic and anaerobic Brewer (5) media in connection with each withdrawal of a sample for analysis. Only such experiments were accepted in which no bacterial growth had occurred after 48 hours.

At the termination of the experiments with the aortic samples the wet weight of the tissue, as mentioned above, was determined. In the investigations on human aortas a portion of the tissue was fixed in formalin solution for histologic examination. The remaining part of the aortic sample was homogenized and aliquots of the homogenate used for determination of the nitrogen (8) and calcium (7) content of

the tissue. Another part of the homogenate was extracted with alcohol-ether, the alcohol-ether evaporated, and the residue redissolved in petroleum ether, as described by Kirk, Page, and Van Slyke (16). The petroleum ether extract served for determination of the cholesterol (12) and lipid (25) content of the tissue.

2. Determination of Tissue Respiration and Respiratory Quotient.—For determination of the respiratory rate and respiratory quotient of the arterial tissue the procedure of Kirk, From Hansen, Effersøe, and Iversen (15) was used. In this procedure aliquots of the medium are transferred at various intervals from the syringe to the extraction chamber of a Van Slyke apparatus for gasometric analysis. The respiration of the tissue is estimated from the observed changes in the oxygen concentration of the medium, the fluid volume in the syringe during each experimental period, and the dry weight of the tissue. The respiratory quotient is obtained directly from the recorded changes in the total carbon dioxide and oxygen concentrations of the medium. In the present study 9 ml. of medium were employed for each gasometric analysis. With the use of aliquots of this size the procedure permits measurements of Q_{o_2} values as low as 0.01. The average difference between Q_{o_2} values obtained in parallel determinations on adjacent tissue samples from the same aorta was 11 per cent. No significant difference in respiratory intensity of samples from the same aorta was found with volumes of medium varying between 10 and 70 ml. per gram of fresh arterial tissue.

Control experiments performed with the buffer medium alone showed no measurable change in the oxygen and carbon dioxide content of the medium over a three hour period.

3. Determination of Rate of Glycolysis.—The lactic acid production by the aortic tissue was measured by withdrawing samples of the medium from the syringe at various intervals and determining the lactic acid content by the colorimetric method of Barker and Summerson (4), as modified by LePage (17). A Coleman No. 14 spectrophotometer was used for the colorimetric assays, which were carried out in triplicate. In the aerobic experiments the withdrawal was made in connection with the transfer of samples to the Van Slyke chamber for gasometric analysis. In the investigations in which the rate of anaerobic glycolysis was measured the oxygen content of the medium was checked at the start of the first experimental period. The oxygen concentration of the medium after aeration with nitrogen varied between 0.00 and 0.15 vol. per cent (mean 0.06 vol. per cent). The rate of glycolysis was calculated from the observed changes in the lactic acid concentration of the medium, the fluid volume in the syringe during each experimental period, and the dry weight of the tissue. Control experiments carried out on the glucose containing medium under both aerobic and anaerobic conditions failed to reveal any spontaneous lactic acid formation in the medium in a three hour period.

In 75 experimental periods concomitant determinations of the lactic acid production were made by the gasometric procedure of Avery and Hastings (3). The Q_g^{o2} values calculated on the basis of the gasometric lactic acid determinations were on the average 20 per cent, and the Q_g^{n2} determinations 26 per cent higher than the values based on colorimetric analyses but otherwise showed a fair agreement with the latter. Since the colorimetric analysis is more specific for lactic acid than the gasometric assay only the results of colorimetrically determined glycolysis values will be reported.

4. Determination of Glucose Utilization.—Measurements of the amount of glucose utilized by the aortic tissue were made in connection with several of the aerobic and anaerobic experiments. For glucose analysis the medium was precipitated with zinc sulfate and barium hydroxide (21) and the glucose content of the filtrate determined by the iodometric copper sulfate procedure in the modification described by Somogyi (22)[1]. The analyses were carried out in triplicate.

In calculation of the glucose balances the as-

[1] The authors are indebted to Dr. M. Somogyi for technical advice concerning the glucose analysis.

sumption was made that glucose was the substance used for the tissue respiration. The amount of glucose utilized for combustion was calculated by the formula: Mg. glucose used = Ml. oxygen consumed x 0.00134. Correction based on the simultaneously determined R. Q. value was not applied.

5. Calculation of Energy Production.—In calculation of the energy production by the tissue the assumption was made that carbohydrate was the source of energy provided and the following equations were used:

(I) Calories derived from combustion = Ml. oxygen consumed x 5.12

(II) Calories derived from glycolysis = Mg. lactic acid produced x 0.344

Equation (I) is derived in the following way. One Gm. of glucose requires 0.746 L. of oxygen for combustion, as the consequence of which 3820 small calories are developed. One ml. of oxygen therefore corresponds to 3820/746 = 5.12 calories.

Concerning the derivation of equation (II) the over-all reaction for the conversion of 1 mol of glucose (from glycogen) to lactic acid (20) is:

1 mol of glucose (from glycogen) + 1 energy rich phosphate bond + 3 H_3PO_4 = 2 mols of lactic acid + 4 energy rich phosphate bonds + 40,000 calories.

If glucose must first be phosphorylated to glucose-6-phosphate one extra energy rich phosphate bond from ATP is required, thereby reducing the yield of energy. Since 1 energy rich phosphate bond corresponds to about 11,000 calories, the total energy production (free and in the form of phosphate bonds) per mol glucose will be: 40,000 calories + (4 — 2) energy rich phosphate bonds, or 40,000 + 2 x 11,000 = 62,000 calories. The energy production per gram of glucose is therefore 62,000/180 = 344 calories, and the energy yield per milligram of lactic acid formed from glucose, 0.344 calories.

6. Symbols.—The following symbols were used for expressing the rate of tissue metabolism:

Q_{o_2}: Cubic millimeters of oxygen consumed per milligram dry tissue per hour

$Q_{o_2}(N)$: Cubic millimeters of oxygen consumed per milligram tissue nitrogen per hour

R. Q.: Respiratory quotient

Q_g^{o2}: Milligrams of lactic acid x 249 produced per milligram dry tissue per hour under aerobic conditions

$Q_g^{o2}(N)$: Milligrams of lactic acid x 249 produced per milligram tissue nitrogen per hour under aerobic conditions

Q_g^{n2}: Milligrams of lactic acid x 249 produced per milligram dry tissue per hour under anaerobic conditions

$Q_g^{n2}(N)$: Milligrams of lactic acid x 249 produced per milligram tissue nitrogen per hour under anaerobic conditions

Although in the present study the lactic acid was measured by direct chemical analysis it was considered of value to convert the figures to the glycolysis units employed by Warburg (26) in order to facilitate comparison with glycolysis rates reported in the literature for other tissues. In the manometric Warburg procedure for determination of glycolysis rates the produced lactic acid is measured indirectly by estimation of the cubic millimeters of carbon dioxide liberated by lactic acid from bicarbonate. Since 1 mg. of lactic acid will liberate 249 cu. mm. of carbon dioxide from bicarbonate, a factor of 249 is employed to convert milligrams of lactic acid to Warburg units.

Results

A. Human Aortas

A summary of the protocols for aerobic metabolism studies performed on 44 samples of human aortas is presented in table 1. The age of the individuals from whom the samples were obtained ranged between 9 days and 89 years. Thirty-six of the subjects were male, 8 female. The table contains besides the Q_{o_2} and Q_g^{o2} values for the experiments the $Q_{o_2}(N)$ and $Q_g^{o2}(N)$ values. Although in the case of some samples with marked arteriosclerotic changes (for instance, No. 31) the lowering of the Q_{o_2} and Q_g^{o2} values caused by the presence of inert material is notable, the use of the $Q_{o_2}(N)$ and $Q_g^{o2}(N)$ computations rather than the ordinary Q_{o_2} and Q_g^{o2} values does not alter the general conclusions drawn from the observations.

TABLE 1. SUMMARY OF PROTOCOLS FOR AEROBIC EXPERIMENTS ON 44 INTACT HUMAN AORTIC SAMPLES (INTIMA-MEDIA PREPARATIONS)

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Sample No.	Sex	Age (Years)	Time After Death		Period	Minutes	Q_{O_2}	$Q_{O_2}(N)$	R. Q.	$Q_g^{O_2}$	$Q_g^{O_2}(N)$	Calcium	Cholesterol	Total [1] Lipid	Dry Matter %
			Days	Hours								In % of Wet Tissue Weight			
1	M	0.03	1	3	1	1745	0.072	0.59	1.06	0.444	3.58	0.08	0.24	0.88	25.0
2	M	0.12	0	12	1	342	0.021	0.17	0.85	0.014	0.12	0.08	0.09	0.82	25.2
3	F	20	0	3½	1	64	0.365	3.10	0.71	1.070	9.10	0.15	0.45	1.46	27.2
4	M	30	0	13	1	123	0.039	0.34	0.53	0.134	1.15	0.28	0.33	1.21	28.8
					2	87	0.011	0.10	1.47						
			1	10	1	183	0.011	0.10	1.49	0.140	1.20				
					2	109	0.020	0.17	0.55	0.164	1.41				
			7	10	1	202				0.074	0.64				
					2	145				0.073	0.63				
			17	11	1	315	0.004	0.03	1.08	0.081	0.69				
			46	13	1	142	0.012	0.10	0.61	0.003	0.03				
					2	77	0.000	0.00		0.008	0.07				
5	M	30	0	17	1	116	0.020	0.17	0.76			0.16	0.34	1.42	25.4
6	M	32	1	0	1	169	0.025	0.32	0.57	0.026	0.33	0.21	0.34	1.25	28.2
7	F	37	0	4½	1	199	0.118	1.05	1.05	0.506	4.52	0.95	1.03	2.44	19.8
			13	4	1	152	0.015	0.13	0.06	0.012	0.11				
					2	114	0.007	0.06	0.93	0.013	0.12				
8	M	39	0	22	1	127	0.022	0.25	0.81	0.058	0.66	0.39	0.55	1.34	26.0
					2	199				0.024	0.27				
9	M	40	0	17	1	105	0.052	0.51	0.58	0.205	2.00	0.20	0.42	1.60	25.6
10	M	42	0	19	1	184	0.028	0.25	1.33	0.224	2.02	0.29	0.84	2.00	25.7
11	M	46	0	19	1	123				0.067	0.75	0.34	2.18	3.15	25.5
					2	134	0.016	0.18	0.45	0.075	0.84				
			12	20	1	146	0.008	0.09	0.90	0.053	0.60				
					2	117	0.004	0.05	0.98	0.031	0.35				
12	M	47	0	12	1	62	0.131	1.23	0.61	0.435	4.08	0.32	0.67	0.94	23.6
			1	10	1	111	0.080	0.76	0.85	0.359	3.39				
					2	177	0.076	0.72	0.92	0.234	2.21				
			10	10	1	189				0.234	2.21				
					2	141	0.024	0.23	0.59	0.341	3.20				
			19	9	1	194	0.000	0.00		0.150	1.41				
					2	117	0.000	0.00		0.145	1.36				
			32	10	1	277	0.000	0.00		0.017	0.18				

[1] Alcohol ether-petroleum ether soluble material.

TABLE 1—Continued

Sample No.	Sex	Age (Years)	Time After Death		Period	Minutes	Qo_2	Qo_2(N)	R. Q.	$Q_E^{O_2}$	$Q_E^{O_2}$(N)	Calcium	Cholesterol	Total [1] Lipid	Dry Matter %
			Days	Hours								In % of Wet Tissue Weight			
13	F	50	0	16	1	77	0.133	1.40	0.92	0.670	8.95	0.23	0.92	1.49	23.7
14	M	51	0	3½	1	49	0.234	3.02		0.685	8.82	0.19	2.83	4.56	25.3
					2	90	0.109	1.40	1.06	0.407	5.24				
					3	115	0.074	0.95	1.25	0.374	4.81				
					4	108	0.057	0.73	1.09						
15	M	51	0	13	1	156	0.152	1.16	0.64	0.407	3.11	0.24	0.93	1.62	25.6
16	M	55	0	4¼	1	64	0.235	2.54	1.20	0.990	10.70	0.21	1.24	2.62	23.6
					2	68	0.147	1.59	1.13	0.614	6.64				
					3	155	0.082	0.89	0.94	0.677	7.32				
17	M	55	0	11	1	75	0.058	0.80	0.56	0.850	11.62	0.68	1.21	1.90	30.9
18	M	55	0	17	1	113	0.032	0.26	0.78	0.373	3.02	0.18	1.41	2.62	24.1
19	M	56	0	14	1	63	0.037	0.37	1.20	0.097	0.98	0.25	2.18	3.11	25.3
			2	13	1	97	0.022	0.22	0.83	0.296	2.98				
					2	77	0.018	0.18	0.72	0.228	2.30				
			10	10	1	201	0.009	0.09	1.10	0.235	2.38				
20	F	58	0	9	1	150	0.070	0.65	0.90	0.276	2.55	0.15	1.12	2.56	29.4
					2	158	0.065	0.60	0.89	0.195	2.24				
21	M	60	0	22	1	123	0.114	1.50	0.97	0.251	3.31	0.50	1.62	2.33	28.0
					2	54	0.100	1.32	1.02						
			3	22	1	130	0.062	0.82	0.94	0.052	0.69				
					2	98	0.074	0.98	0.90	0.054	0.71				
22	M	60	0	5½	1	84	0.071	0.65	0.96	0.303	2.76	0.30	1.01	1.94	34.2
23	M	62	0	10	1	165	0.030	0.27	0.60	0.280	2.52	0.34	1.81	3.68	19.3
					2	90	0.041	0.37	0.62	0.187	1.68				
24	M	62	0	2¼	1	28	0.217	2.69		0.904	11.18	3.29	2.45	3.67	25.2
					2	119	0.143	1.77	1.03	0.473	5.86				
					3	117	0.125	1.55	1.05	0.515	6.40				
			1	3	1	157	0.119	1.48	0.98	0.515	6.40				
					2	75	0.106	1.32	0.90	0.230	2.85				
			6	0	1	154	0.057	0.71	0.71	0.114	1.42				
					2	237	0.075	0.93	0.93	0.318	3.95				

[1] Alcohol ether-petroleum ether soluble material.

TABLE 1—Continued

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Sample No.	Sex	Age (Years)	Time After Death		Period	Minutes	Qo_2	$Qo_2(N)$	R. Q.	$Q_E^{O_2}$	$Q_E^{O_2}(N)$	Calcium	Cholesterol	Total[1] Lipid	Dry Matter %
			Days	Hours								In % of Wet Tissue Weight			
25	M	65	0	7	1	44	0.138	1.60	0.98	0.265	3.08	0.43	1.59	2.66	25.6
					2	30	0.063	0.73	1.06	0.184	2.14				
					3	54	0.103	1.19	1.01	0.590	6.85				
			3	7	1	64	0.082	0.95	1.10	0.402	4.66				
					2	67	0.099	1.15	1.00	0.542	6.30				
			8	5	1	65	0.043	0.50	0.89	0.455	5.29				
					2	57	0.061	0.71	1.02	0.277	3.21				
			64	5	1	328	0.008	0.09	0.72	0.002	0.02				
						1035	0.003	0.03		0.002	0.02				
26	M	65	0	23	1	144	0.015	0.21	0.41	0.154	2.19	0.11	1.12	2.32	25.0
27	M	67	0	14	1	172	0.030	0.31	0.90	0.178	1.85	0.26	2.34	3.85	26.0
					2	88	0.030	0.31	1.23	0.118	1.22				
28	M	67	0	4½	1	47	0.221	2.09	1.10	0.834	7.86	0.57	1.50	2.70	24.8
					2	81	0.152	1.44	0.94	0.585	5.54				
					3	96	0.126	1.19	0.99	0.455	4.30				
					4	115	0.112	1.06	1.01						
			2	5	1	106	0.110	1.04	1.10	0.366	3.56				
					2	80	0.093	0.88	1.00	0.368	3.58				
			8	4	1	168	0.086	0.81	0.88	0.450	4.25				
					2	66	0.078	0.74	0.92	0.368	3.48				
			20	2	1	228	0.034	0.32	0.56	0.340	3.21				
					2	615				0.225	2.13				
29	M	67	0	16	1	76	0.073	0.67	0.67	0.373	3.41	0.29	1.25	2.37	24.8
					2	78	0.059	0.54	0.54	0.283	2.59				
30	M	68	0	10	1	212	0.065	0.84	1.09	0.202	2.60	0.43	0.78	1.62	28.5
					2	109	0.071	0.91	0.72	0.304	3.91				
31	M	68	0	4½	1	49	0.046	1.16		0.320	8.08	1.98	2.82	3.71	40.3
					2	320	0.027	0.66		0.103	2.60				
					3	158	0.022	0.56		0.091	2.30				
32	F	68	0	18	1	101	0.102	1.14	0.71	0.473	5.28	0.49	1.03	1.29	27.5
33	M	70	0	9	1	145	0.084	0.96	1.09	0.435	4.94	0.62	2.12	3.99	26.9
					2	58	0.071	0.81	1.07	0.320	3.63				

[1] Alcohol ether-petroleum ether soluble material.

TABLE 1—Continued

Sample No.	Sex	Age (Years)	Time After Death		Period	Minutes	Q_{O_2}	Q_{O_2}(N)	R. Q.	$Q_g^{O_2}$	$Q_g^{O_2}$(N)	Calcium	Cholesterol	Total[1] Lipid	Dry Matter %
			Days	Hours								In % of Wet Tissue Weight			
34	M	72	1	0	1	137	0.103	1.03	0.48	0.254	2.54	0.33	0.80	1.60	24.8
					2	150	0.049	0.49	1.14	0.080	0.80				
35	M	74	0	15	1	138	0.044	0.49	1.16	0.272	3.01	0.54	0.83	1.94	27.4
					2	145	0.043	0.48	0.92	0.187	2.07				
			16	15	1	294	0.060	0.67	1.08	0.083	0.92				
					2	100	0.043	0.48	1.21	0.098	1.09				
36	M	74	0	5	1	177	0.030	0.47	0.95	0.125	1.95	0.49	2.70	4.11	32.8
					2	131	0.024	0.37	1.77	0.082	1.27				
			7	6	1	142	0.021	0.33	1.42	0.090	1.40				
					2	149	0.016	0.25	1.42						
37	M	75	0	13	1	130	0.053	0.58	0.91	0.266	2.88	0.39	1.76	3.63	33.1
					2	84	0.040	0.43	0.91	0.158	1.71				
			10	9	1	184	0.014	0.15	0.86	0.095	1.03				
					2	125	0.014	0.15	0.86	0.136	1.47				
38	M	75	1	2	1	149	0.010	0.12	1.11	0.029	0.33	0.70	1.61	3.16	27.2
					2	117	0.009	0.11	1.08	0.012	0.14				
			9	1	1	252	0.008	0.09	1.08	0.040	0.46				
39	F	75	0	12	1	96	0.101	1.05	0.77	0.602	6.23	0.47	1.19	2.33	28.3
40	M	76	1	8	1	111	0.023	0.21	0.48	0.022	0.21	0.33	1.30	2.94	31.4
					2	78	0.015	0.14	0.24	0.077	0.72				
41	F	82	1	1	1	110	0.047	0.63	1.16	0.365	4.92	1.38	3.40	5.41	28.0
					2	97	0.048	0.65	1.38	0.339	4.44				
42	F	85	0	9	1	224	0.047	0.57	1.90	0.425	5.18	0.50	1.45	3.00	26.7
					2	148	0.066	0.81	0.99	0.248	3.02				
43	M	87	1	3	1	183	0.010	0.12	1.18	0.087	1.04	0.72	2.52	3.67	27.4
					2	103	0.010	0.12	0.99	0.071	0.86				
			13	4	1	316	0.007	0.08	0.81	0.013	0.15				
44	M	89	0	9	1	95	0.066	0.81	0.93	0.229	2.80	0.72	1.49	2.88	28.1
					2	111	0.065	0.79	0.96	0.229	2.80				

[1] Alcohol ether-petroleum ether soluble material.

I. *Respiration*

1. General.—It was observed during the course of the study that the Q_{O_2} value of fresh human aortic tissue tends to decrease rapidly when the sample is maintained at 37 C. The decrease in respiration was usually found to be most marked in the case of samples having an initial high Q_{O_2} (see No. 14, 16, 24, and 28). The decrease occurred both when the tissue was suspended in buffer medium and when it was kept in air saturated with water vapor. In contrast to this no fall or only a slight decrease in respiratory rate was found in the case of tissue samples stored for a period of several hours at 4 C.; when the samples were stored for three days or longer at refrigerator temperature a definite decrease in respiratory rate also took placed under these conditions. When sections of fresh aortic tissue, which had been kept for a period of hours at 4 C., subsequently were suspended in buffer medium at 37 C., a rapid decrease in respiration almost regularly set in. This general behavior of the aortic tissue is illustrated in figures 1 and 2. Because of the marked decrease in respiration occurring with samples maintained at 37 C., Q_{O_2} values measured during initial experimental periods may be expected to approximate more closely the true metabolic rate of the tissue than values obtained in subsequent periods.

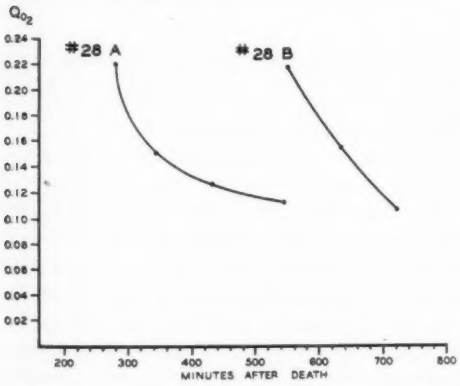

FIG. 1. Decrease in respiration of human aortic tissue at 37 C.

One sample of a human aorta (No. 28 A) was placed in buffer medium at 37 C. about 4½ hours after death, whereas a similar preparation of the same aorta (No. 28 B) was stored in the refrigerator at 4 C. for another 4½ hours and then suspended in 37 C. warm buffer. The figure shows that no certain decrease in respiratory ability occurred as the result of the 4½ hour storage at 4 C., whereas the Q_{O_2} of both samples decreased rapidly after the tissue had been subjected to a temperature of 37 C.

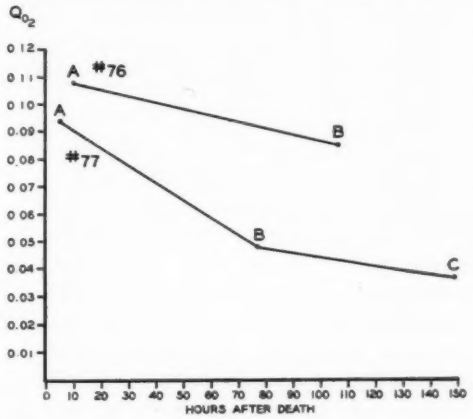

FIG. 2. Effect of storage of human aortic tissue at 4 C. for several days on tissue respiration.

One sample of a human aorta (No. 76 A) was subjected to respiration measurements at 37 C. 10 hours after death, whereas a similar preparation of the same aorta (No. 76 B) was stored in the refrigerator at 4 C. for another 96 hours. The figure shows that a decrease in respiratory ability had occurred as the result of the 4 days' storage of the tissue at refrigerator temperature. Similar results were obtained in experiments on another human aorta (No. 77), of which samples were examined 5 hours after death (No. 77 A) and after 3 (No. 77 B) and 6 (No. 77 C) days' storage at 4 C.

2. Initial Respiration Values.—Since it must be assumed that the factors causing a decrease in the Q_{O_2} value of human aortic tissue when the samples are maintained at 37 C. to a greater or lesser extent are operative before removal of the artery from the body, a study was made of the correlation between the time elapsed after the death of the individual and the initial Q_{O_2} values of the samples. A survey of the mean initial Q_{O_2} values arranged according to the time elapsed after death is given in table 2. The data show a marked decline in respiratory intensity with time elapsed after death.

TABLE 2. CORRELATION BETWEEN TIME ELAPSED AFTER DEATH AND INITIAL Q_{O_2} VALUES OF 44 HUMAN AORTIC SAMPLES.

Time After Death (Hours)	No. of Samples	Mean Q_{O_2}	Range	S. D. of Distribution
2— 4	3	0.26	0.22—0.34	0.07
4— 8	7	0.12	0.05—0.24	0.08
8—12	7	0.06	0.03—0.08	0.01
12—16	10	0.07	0.02—0.15	0.05
16—24	10	0.05	0.02—0.11	0.03
24—32	7	0.04	0.01—0.10	0.03

It will be seen from the table that initial respiration values were obtained on 3 samples within four hours after death and that the Q_{O_2} values of these samples were of the magnitude 0.22 to 0.36.

The marked influence of the time elapsed after the individual's death on the initial Q_{O_2} value of human aortic tissue makes an analysis of the existence of a correlation between the age of the individual and the respiratory rate of the tissue difficult. A study of the data presented in table 2 shows that the influence of the time elapsed after death is less pronounced in the case of samples examined 8 or more hours after death, the range of the mean initial Q_{O_2} values for the period 8 to 32 hours being only moderate. The distribution of the Q_{O_2} values (34 samples) for this period in relation to the age of the individuals is presented in figure 3. The figure fails to show any consistent change in Q_{O_2} with advancing age.

A computation was made in the case of the above mentioned 34 aortic samples of the correlations between the calcium content and the total lipid content of the tissue on one side and the initial Q_{O_2} and $Q_{O_2}(N)$ values on the other side. As seen from the values stated below none of the calculated correlation coefficients are statistically significant. The cholesterol values, because of their distribution, did not lend themselves to a calculation of the correlation coefficient.

Calcium content of tissue/initial Q_{O_2}
: $r = -0.01$ ($t = 0.05$, $N = 34$)

Calcium content of tissue/initial $Q_{O_2}(N)$
: $r = +0.01$ ($t = 0.05$, $N = 34$)

Total lipid content of tissue/initial Q_{O_2}
: $r = -0.29$ ($t = 1.34$, $N = 34$)

Total lipid content of tissue/initial Q_{O_2} (calculated on basis of lipid free dry weight)
: $r = -0.24$ ($t = 1.39$, $N = 34$)

Total lipid content of tissue/initial $Q_{O_2}(N)$
: $r = -0.23$ ($t = 1.34$, $N = 34$)

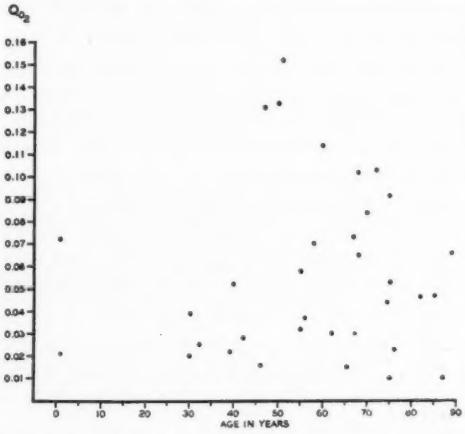

FIG. 3. Initial Q_{O_2} values of 34 human aortic samples examined 8 to 32 hours after death of the individual. The data fail to show any consistent change in Q_{O_2} with advancing age.

3. Respiration Values After Prolonged Storage of Samples at 4 C.—After the initial Q_{O_2} values had been determined 14 of the aortic samples were stored under sterile conditions in the refrigerator at 4 C. for periods of days or weeks and measurements of the respiratory rate of the samples performed at various intervals. The observations, included in table 1 and presented graphically in figure 4, show a marked tendency for the Q_{O_2} values to decrease with time. Part of this decrease, as previously explained, is caused by the necessary heating of the samples to 37 C. in connection with the respiration measurements. In 4 instances the respiration of the samples was examined over a period of more than 20 days. It was found that 1 of these samples (No. 12) had ceased respiring on the 19th day, whereas the remaining 3 aortic samples (No. 28, 4, and 25) still

showed a detectable oxygen consumption when examined respectively 20, 46, and 64 days after the death of the individual. These findings permit the conclusion that the respiratory ability of human aortic tissue, although greatly reduced, can be maintained for several days or weeks after death.

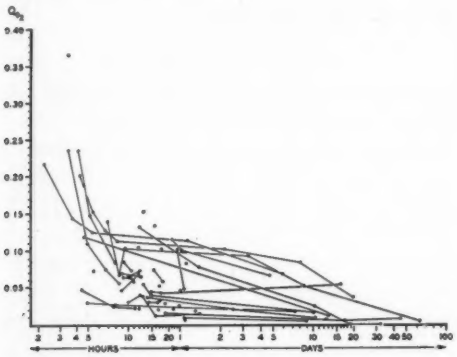

FIG. 4. Effect of prolonged storage at 4 C. (and intermittent determination of metabolism at 37 C.) on Q_{O_2} values of human aortas. Logarithmic scale used for the abscissa.

4. Comparison of the Respiratory Rates of the Intima, Media, and Intact Intima-Media of the Same Aortas.—In order to compare the respiratory rates of the layers of the aortic wall parallel determinations were carried out on preparations of the isolated intima (with attached subintimal tissue), the media, and the intact intima-media from the same aortas. The results of such comparative determinations on 5 different aortas are shown in table 3.

The variations observed in some of the experiments may have been caused by the inclusion of inert calcium and lipid material in some of the intima samples or by a decrease in analytic accuracy associated with studies on small tissue samples. The mean Q_{O_2} values for the intima, media, and intima-media of the 5 aortas were, respectively, 0.048, 0.046, and 0.041.

II. *Respiratory Quotient*

1. General.—The respiratory quotient of the human aortic samples frequently showed a notable variation between the values obtained

TABLE 3. COMPARISON OF Q_{O_2} VALUES FOR THE INTIMA, MEDIA AND INTACT INTIMA-MEDIA OF THE SAME HUMAN AORTAS.

Sample No.	Time After Death (Hours)	Q_{O_2}		
		Intima	Media	Intima-Media
23	10	0.014	0.028	0.030
			0.026	0.041
36	5	0.042	0.052	0.030
		0.023	0.042	0.024
37	13	0.013	0.057	0.053
		0.010	0.050	0.040
43	27	0.006	0.005	0.010
		0.010		0.010
44	9	0.130	0.078	0.066
			0.064	0.065

in successive periods within a single experiment (table 1). No consistent trend in this variation could be discovered.

2. Initial R. Q. Values—The average respiratory quotient observed in initial experiments on 43 human aortic samples was 0.91 (s. d. of distribution 0.28). A histogram illustrating the distribution of the R. Q. values as observed in 97 experimental periods in initial experiments on the 43 aortic samples is presented in figure 5. As seen from table 4 the quotient showed a tendency to decrease with the time elapsed after the death of the individual.

TABLE 4. CORRELATION BETWEEN TIME ELAPSED AFTER DEATH AND INITIAL R. Q. VALUES OF 43 HUMAN AORTIC SAMPLES.

Time After Death (Hours)	No. of Samples	Mean R. Q.	Range	S. D. of Distribution
2— 4	3	0.97	0.71—1.15	0.22
4— 8	6	1.07	0.96—1.25	0.11
8—12	7	0.93	0.56—1.46	0.30
12—16	10	0.86	0.61—1.20	0.19
16—24	10	0.74	0.41—1.33	0.28
24—32	7	0.92	0.41—1.26	0.30

The table further reveals that the variation between the mean initial R. Q. values observed between 12 and 32 hours after death is com-

paratively small. The data for the 27 samples examined within this time interval were therefore subjected to statistical analysis of various correlations, which are listed below:

Age of individual/initial R. Q.
: $r = +0.10$ ($t = 0.50$, $N = 27$)

Calcium content of tissue/initial R. Q.
: $r = +0.41$ ($t = 2.25$, $N = 27$)

Cholesterol content of tissue/initial R. Q.
: $r = +0.33$ ($t = 1.75$, $N = 27$)

Total lipid content of tissue/initial R. Q.
: $r = +0.31$ ($t = 1.63$, $N = 27$)

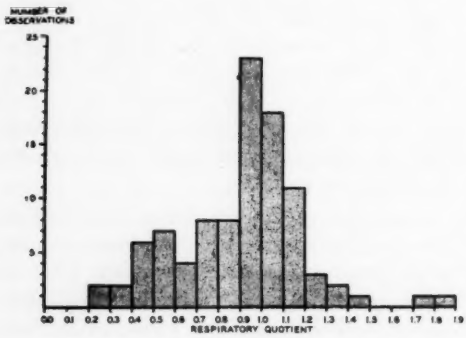

FIG. 5. Histogram illustrating the distribution of R.Q. values as observed in 97 experimental periods in initial experiments on 43 human aortic samples. Mean value of determinations, 0.91.

The calculated r values show the existence in the present series of experiments of a significant positive correlation between the calcium content of the tissue and the R. Q. value, whereas the remaining correlations are not significant at the 5 per cent level of confidence.

3. R. Q. Values After Prolonged Storage of Samples at 4 C.—Determinations of the respiratory quotients of aortic samples stored at 4 C. for periods up to 20 days showed a certain tendency to a further decrease. A more marked decrease in the respiratory quotient was observed in the case of 3 aortic samples examined after 20, 46, and 64 days of storage, the R. Q. values for these samples being 0.56, 0.61, and 0.00, respectively.

4. Comparison of Respiratory Quotients of the Intima, Media, and Intact Intima-Media of the Same Aortas.—A comparison was made in the case of 5 aortic samples (12 experimental periods) of the respiratory quotients of the isolated intima, media, and intact intima-media. The measurements showed a somewhat lower R. Q. value for the intima than for the media and intima-media, the mean respiratory quotients for the 3 preparations being, respectively, 0.59, 0.91, and 0.96.

III. *Aerobic Glycolysis*

Measurements of the rate of aerobic glycolysis were performed on 43 samples of intact human aortas (intima-media preparations) in connection with the determination of the respiratory rate. The observed $Q_g^{O_2}$ and $Q_g^{O_2}$ (N) values are listed in table 1.

1. General.—A similar, although less consistent tendency was observed for the rate of aerobic glycolysis to decrease when the samples were maintained at 37 C. as was noted for the respiration of the tissue. In further resemblance with the behavior of the respiration, the aerobic glycolysis failed to decline or showed only a slight fall when the tissue samples were stored for a period of several hours at 4 C.; when the samples were stored for two days or longer at refrigerator temperature a definite decrease in the glycolysis rate also took placed under these conditions. When sections of fresh aortic tissue, which had been kept for a period of hours at 4 C., subsequently were suspended in buffer medium at 37 C. a significant decrease in the glycolysis rate usually set in. This general behavior of the aortic tissue is illustrated in figures 6 and 7.

2. Initial Glycolysis Values.—The maximum initial $Q_g^{O_2}$ values observed for the human aortic samples were 0.900 to 1.120.

An analysis of the effect of the time elapsed after death on the initial $Q_g^{O_2}$ values of the samples revealed a definite tendency for the values to decrease with advancing time (table 5). As seen from the table the variation in the mean aerobic glycolysis rates for the 17 samples examined between 8 and 16 hours after death is only moderate, and the observations on these samples have therefore been

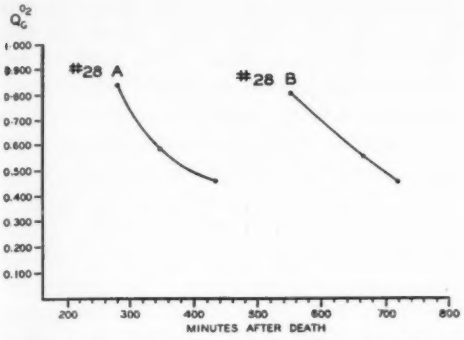

FIG. 6. Decrease in rate of aerobic glycolysis of human aortic tissue at 37 C.

One sample of a human aorta (No. 28 A) was placed in buffer medium at 37 C. about 4½ hours after death, whereas a similar preparation of the same aorta (No. 28 B) was stored in the refrigerator at 4 C. for another 4½ hours and then suspended in 37 C. warm buffer. The figure shows that no certain decrease in glycolytic ability occurred as the result of the 4½ hour storage at 4 C., whereas the $Q_g^{O_2}$ of both samples decreased significantly after the tissue had been subjected to a temperature of 37 C.

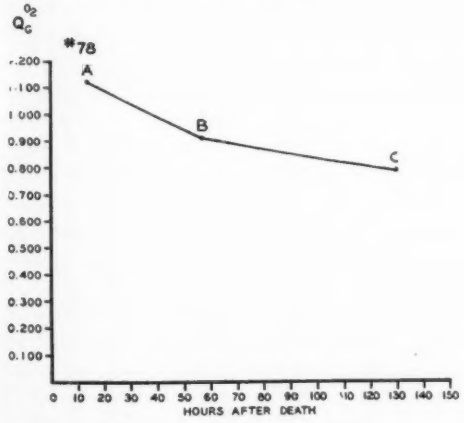

FIG. 7. Effect of storage of human aortic tissue at 4 C. for several days on rate of aerobic glycolysis.

One sample of a human aorta (No. 78 A) was subjected to measurements of aerobic glycolysis 13 hours after death, whereas 2 other preparations of the same aorta (No. 78 B and 78 C) were stored in the refrigerator at 4 C. for another 44 and 117 hours, respectively. The figure shows that a definite decrease in the glycolytic ability had occurred as the result of the 2 and 5 days' storage of the tissue at refrigerator temperature.

used for calculation of various correlation coefficients, which are listed below:

Age of individual/initial $Q_g^{O_2}$
: $r = -0.24$ ($t = 0.96$, $N = 17$)
Age of individual/initial $Q_g^{O_2}(N)$
: $r = +0.17$ ($t = 0.67$, $N = 17$)
Calcium content of tissue/initial $Q_g^{O_2}$
: $r = +0.41$ ($t = 1.74$, $N = 17$)
Calcium content of tissue/initial $Q_g^{O_2}(N)$
: $r = +0.44$ ($t = 1.90$, $N = 17$)

As seen from the t values given for the various correlation coefficients, none of the coefficients are statistically significant at the 5 per cent level of confidence. The cholesterol and total lipid values, because of their distribution, did not lend themselves to calculation of correlation coefficients.

TABLE 5. CORRELATION BETWEEN TIME ELAPSED AFTER DEATH AND INITIAL $Q_g^{O_2}$ VALUES OF 43 HUMAN AORTIC SAMPLES.

Time After Death (Hours)	No. of Samples	Mean $Q_g^{O_2}$	Range	S. D. of Distribution
2— 4	3	0.886	0.685—1.070	0.190
4— 8	7	0.493	0.125—0.990	0.318
8—12	7	0.385	0.202—0.850	0.224
12—16	10	0.308	0.014—0.606	0.220
16—24	9	0.243	0.058—0.473	0.139
24—32	7	0.177	0.022—0.444	0.175

3. $Q_g^{O_2}$ Values After Prolonged Storage of Samples at 4 C.—Determinations of the $Q_g^{O_2}$ values of 14 aortic samples stored in the refrigerator at 4 C. for periods of days or weeks showed a definite tendency for the glycolysis rates to decrease with time (fig. 8). Part of this decrease, as explained above, is caused by the necessary heating of the samples to 37 C. in connection with the glycolysis rate measurements. Three samples (No. 12, 4, and 25) examined after 32, 46, and 64 days of storage still showed a small but measurable glycolysis.

4. Comparison of Aerobic Glycolysis Rates of the Intima, Media, and Intact Intima-Media

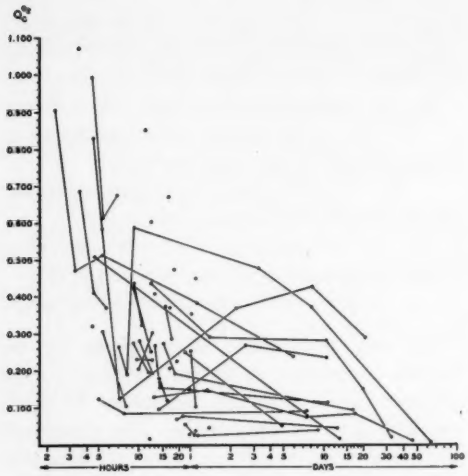

FIG. 8. Effect of prolonged storage at 4 C. (and intermittent determination of metabolism at 37 C.) on $Q_g^{O_2}$ values of human aortas. Logarithmic scale used for the abscissa.

of the Same Aortas.—Parallel determinations of the aerobic glycolysis rates were carried out on preparations of the isolated intima, media, and intact intima-media from 4 human aortas. In addition, comparative measurements were made on the media and intima-media of 2 samples. The results, presented in table 6, show that the glycolysis rates for the 3 preparations generally were of the same order of magnitude. The mean $Q_g^{O_2}$ values for the intima, media, and intima-media in the 9 experiments performed on the 4 aortas were, respectively, 0.151, 0.193, and 0.143.

TABLE 6. COMPARISON OF $Q_g^{O_2}$ VALUES FOR THE INTIMA, MEDIA, AND INTACT INTIMA-MEDIA OF THE SAME HUMAN AORTAS.

Sample No.	Time After Death (Hours)	$Q_g^{O_2}$		
		Intima	Media	Intima-Media
36	5	0.318	0.146	0.125
		0.114	0.104	0.082
	174	0.112	0.175	0.090
37	13	0.205	0.274	0.266
		0.100	0.161	0.158
43	27	0.015	0.091	0.087
		0.061		0.071
44	9	0.236	0.382	0.229
			0.329	0.229
23	10		0.307	0.280
			0.163	0.187
27	14		0.187	0.178
			0.067	0.118

5. Glucose Utilization.—Determinations of the amounts of glucose which disappeared from the glucose containing buffer medium during the aerobic experiments were carried out on 14 samples of human aortas (intact intima-media preparations). The results, expressed as mg. glucose/1000 mg. dry tissue/hour, are presented in column 4 of table 7. The table further contains the calculated balance values for the various samples (column 6).

TABLE 7. GLUCOSE UTILIZATION AND GLUCOSE BALANCE BY INTACT INTIMA-MEDIA PREPARATIONS OF 14 HUMAN AORTAS UNDER AEROBIC CONDITIONS.

Sample No.	Time After Death (Hours)	Period (Minutes)	Glucose Disappeared	Glucose Accounted for Through Combustion and Glycolysis	Balance
			Mg. Glucose/1000 Mg. Dry Tissue/Hour		
7	4½	199	2.0	2.2	−0.2
11	19	257	0.5	0.3	+0.2
20	9	308	1.3	1.0	+0.3
21	22	177	1.5	0.9	+0.6
23	10	255	2.1	1.1	+1.0
25	7	128	4.3	1.7	+2.6
	79	64	2.7	1.3	+1.4
	197	122	1.2	1.6	−0.4
26	23	144	−0.4	0.6	−1.0
27	14	260	1.0	0.7	+0.3
35	15	283	1.2	1.0	+0.2
	384	394	0.5	0.4	+0.1
36	5	308	1.4	0.5	+0.9
	174	142	−0.4	0.4	−0.8
37	13	214	1.1	1.0	+0.1
41	25	207	2.0	1.5	+0.5
43	26	183	0.4	0.3	+0.1
	316	316	0.1	0.1	0.0
44	9	206	1.6	1.0	+0.6

The average amount of glucose which disappeared from the medium during the initial experiments performed on the samples was 1.5 mg./1000 mg. dry tissue/hour. It will be seen

from the table that in 12 out of the 14 initial experiments more glucose disappeared from the medium than could be accounted for through the simultaneously determined tissue respiration and glycolysis. In the remaining 2 experiments slightly more glucose was utilized by the samples than corresponding to the observed changes in the glucose content of the medium. The average balance for the 14 experiments was + 0.4 mg. glucose/1000 mg. dry tissue/hour.

In connection with 4 of the 14 experiments parallel determinations were made on preparations of the isolated intima, media, and intact intima-media. The results showed that an average of 0.6, 0.9, and 1.3 mg. of glucose/1000 mg. dry tissue/hour, respectively, disappeared from the medium in the experiments on the 3 tissue preparations. The corresponding glucose balances were 0.0, 0.0, and + 0.6 mg./1000 mg. dry tissue/hour.

6. Energy Production Through Tissue Respiration and Glycolysis.—The percentages of the energy production by the tissue provided by the tissue respiration and by the glycolysis were calculated for all the experiments in which both the Q_{O_2} and $Q_g^{O_2}$ values of the aortic samples were determined.

The calculation showed that the tissue respiration in the initial experiments on 43 different preparations of intact intima-media contributed an average of 49 per cent (s. d. of distribution 12.4) and the glycolysis an average of 51 per cent of the total energy production by the tissue. A histogram illustrating the distribution of the percentage contribution of the respiration to the total energy production by the tissue as observed in 98 experimental periods in initial experiments on the 43 aortic samples is presented in figure 9.

On the basis of the calculated energy production the average decrease in tissue respiration and in rate of aerobic glycolysis were found to be of the same order of magnitude during the first 32 hours after death. In order to investigate the subsequent comparative magnitude of the tissue respiration and glycolysis a calculation was made of the energy

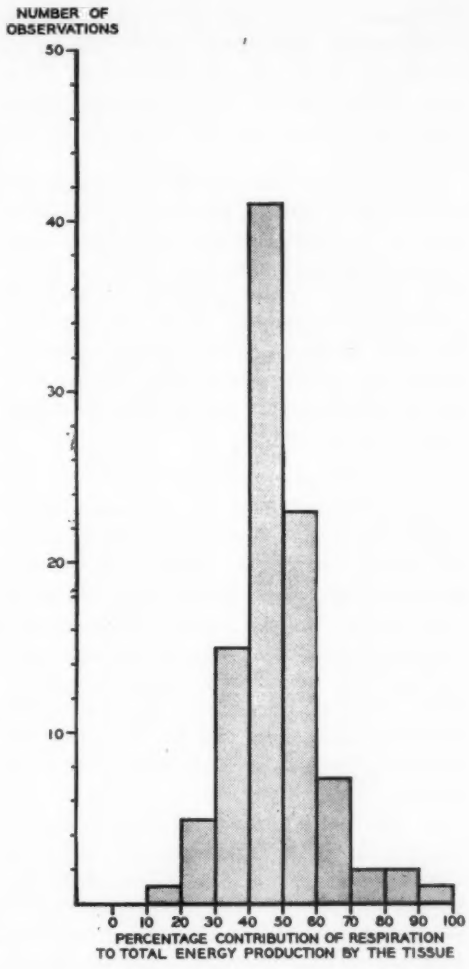

FIG. 9. Histogram illustrating the distribution of the percentage contribution of the respiration to the total energy production by the tissue as observed in 98 experimental periods in initial experiments on 43 human aortic samples. Mean value of determinations, 49 per cent.

production provided by the respiration and the glycolysis by samples, which had been stored for several days in the refrigerator at 4 C. The investigation showed a decrease with advancing time in the percentage of energy derived from the tissue respiration, the mean contribution of the respiration to the total energy produc-

tion after 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 days being, respectively, 53, 51, 50, 49, 49, 43, 41, 39, 40, 39, 40, and 40 per cent. These data indicate that the decline in respiration is somewhat greater than the decline in aerobic glycolysis with time.

In connection with 5 of the 43 experiments parallel determinations were made on preparations of the isolated intima, media, and intact intima-media from the same aortas. The results showed a close agreement between the percentage contributions of the respiration to the total energy production by the tissue, the mean value for the intima being 44.5 per cent, for the media 45.2 per cent, and for the intima-media 46.0 per cent.

IV. *Anaerobic Glycolysis*

Measurements of the rate of anaerobic glycolysis were performed on 14 samples of intact human aortas. A summary of the protocols for these experiments is given in table 8.

1. Initial Glycolysis Values.—The maximum initial glycolysis value observed was 0.900. The average Q_g^{n2} value for 6 aortic samples examined within 12 hours after the death of the individual was 0.484, and for 8 samples examined between 12 and 28 hours after death, 0.240.

2. Q_g^{n2} Values After Prolonged Storage of Samples at 4 C.—Determinations of the Q_g^{n2} values of 10 aortic samples (intima-media preparations) stored in the refrigerator at 4 C. for periods of days or weeks showed a definite tendency for the glycolysis rates to decrease with time (fig. 10). Three aortic samples (No. 20, 30, and 11) examined 70, 89, and 108 days after the death of the individual still retained a slight but measurable glycolytic ability.

3. Comparison of Parallel Determinations of Aerobic and Anaerobic Glycolysis Rates.—Parallel determinations of the aerobic and anaerobic rates of glycolysis were carried out on samples from the same aorta in 29 experiments (table 9). The measurements showed a high degree of correlation, the coefficient of correlation Q_g^{o2}/Q_g^{n2} being + 0.66 (t: 4.56, N: 29). The rate of anaerobic glycolysis in these experiments was on the average 30 per cent higher than the rate of aerobic glycolysis.

TABLE 8. SUMMARY OF PROTOCOLS FOR ANAEROBIC EXPERIMENTS ON 14 INTACT HUMAN AORTIC SAMPLES (INTIMA-MEDIA PREPARATIONS).

Sample No.	Sex	Age (Yrs.)	Time After Death		Period	Minutes	Q_g^{n2}	$Q_g^{n2}(N)$
			Days	Hrs.				
7	F	37	0	5	1	197	0.765	6.72
					2	96	0.150	1.34
			14	4	1	243	0.030	0.27
					2	116	0.009	0.08
8	M	39	0	23	1	119	0.104	1.17
					2	167	0.109	1.23
			11	19	1	110	0.055	0.62
					2	61	0.051	0.58
10	M	42	0	20	1	150	0.337	3.02
11	M	46	0	21	1	110	0.179	2.00
					2	102	0.167	1.87
			13	19	1	165	0.087	0.98
					2	117	0.075	0.84
			36	21	1	119	0.009	0.10
					2	96	0.018	0.20
			71	21	1	80	0.003	0.03
					2	51	0.007	0.08
			108	0	1	287	0.002	0.02
20	F	58	0	11	1	141	0.169	2.10
					2	149	0.148	1.84
			25	15	1	146	0.117	1.46
					2	228	0.081	1.01
			49	10	1	182	0.038	0.47
					2	71	0.037	0.46
			70	10	1	61	0.011	0.14
					2	33	0.027	0.34
21	M	60	0	23	1	100	0.472	6.21
					2	51	0.490	6.45
23	M	62	0	11	1	144	0.220	1.98
					2	117	0.191	1.72
30	M	68	0	11	1	200	0.900	11.50
					2	84	0.267	2.40
			12	6	1	133	0.274	3.51
					2	81	0.192	2.46
			30	5	1	87	0.080	1.02
					2	95	0.064	0.82
			58	5	1	74	0.037	0.47
					2	110	0.019	0.24
			89	5	1	127	0.036	0.46
					2	277	0.008	0.10
33	M	70	0	10	1	109	0.445	5.05
					2	59	0.479	5.44
34	M	72	1	0	1	94	0.352	3.52
					2	120	0.161	1.61

TABLE 8—Continued

Sample No.	Sex	Age (Yrs.)	Time After Death		Period	Minutes	$Q_g^{n_2}$	$Q_g^{n_2}(N)$
			Days	Hrs.				
(34)			8	22	1	638	0.243	2.43
			21	2	1	60	0.105	1.05
					2	54	0.065	0.65
			48	0	1	172	0.012	0.12
					2	109	0.013	0.13
35	M	74	0	16	1	123	0.275	3.05
					2	131	0.220	2.44
			16	15	1	127	0.045	0.50
					2	214	0.040	0.44
			43	19	1	89	0.008	0.09
38	M	75	1	2	1	172	0.022	0.25
					2	117	0.019	0.22
			9	3	1	163	0.029	0.33
41	F	82	1	4	1	81	0.232	2.97
44	M	89	0	10	1	87	0.406	4.96
					2	118	0.313	3.82
			22	5	1	279	0.056	0.68
					2	113	0.043	0.53
			45	8	1	204	0.056	0.68
					2	200	0.056	0.68

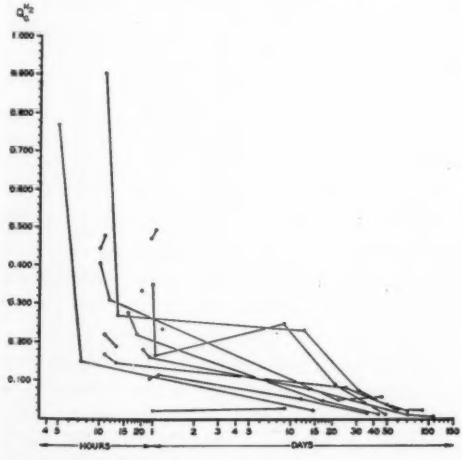

FIG. 10. Effect of prolonged storage at 4 C. (and intermittent determination of metabolism at 37 C.) on $Q_g^{n_2}$ values of human aortas. Logarithmic scale used for the abscissa.

4. Glucose Utilization.—Determinations of the amount of glucose which disappeared from the glucose containing medium during the anaerobic experiments were performed on 8 samples of human aortas (intima-media preparations). The results, expressed as mg. glucose/1000 mg. dry tissue/hour and the computed balance values are presented in table 10. The average amount of glucose which disappeared from the medium during the initial experiments on the samples was 1.9 mg./1000 mg. dry tissue/hour and the mean balance + 0.6 mg./1000 mg. dry tissue/hour.

TABLE 9. PARALLEL DETERMINATIONS OF AEROBIC AND ANAEROBIC RATES OF GLYCOLYSIS (HUMAN AORTAS).

$Q_g^{o_2}$	$Q_g^{n_2}$
0.012	0.030
0.013	0.009
0.019	0.020
0.024	0.109
0.031	0.075
0.040	0.029
0.041	0.022
0.053	0.087
0.058	0.104
0.075	0.174
0.080	0.161
0.083	0.045
0.098	0.040
0.187	0.191
0.187	0.220
0.195	0.148
0.202	0.900
0.224	0.337
0.229	0.353
0.251	0.472
0.254	0.356
0.272	0.275
0.276	0.169
0.280	0.220
0.304	0.267
0.320	0.479
0.352	0.232
0.435	0.445
0.506	0.565

V. *Histologic Studies*[1]

In several instances a comparison was made between histologic preparations of aortic samples which had been fixed in formalin solution immediately after the aortas were ob-

[1] The authors are indebted to Dr. T. Kheim for carrying out the histologic studies on the aortic samples.

TABLE 10. GLUCOSE UTILIZATION AND GLUCOSE BALANCE BY INTACT INTIMA-MEDIA PREPARATIONS OF 8 HUMAN AORTAS UNDER ANAEROBIC CONDITIONS.

Sample No.	Time After Death (Hours)	Period (Minutes)	Glucose Disappeared	Lactic Acid Formed	Balance
			Mg./1000 Mg. Dry Tissue/Hour		
7	5	293	2.5	2.3	+0.2
11	21	212	2.3	0.7	+1.6
20	11	290	0.7	0.6	+0.1
21	23	151	1.8	1.8	0.0
23	11	261	0.7	0.9	−0.2
35	16	254	1.8	1.0	+0.8
	399	341	0.5	0.2	+0.3
41	28	81	3.3	0.9	+2.4
44	10	205	2.0	1.8	+0.2

tained at autopsy and samples from the same aortas which had been used for aerobic or anaerobic metabolism studies for periods up to 50 days. Examination of the stored samples showed that the intima was relatively intact. The nuclei of the smooth muscle cells of the media were still discernible, but their number definitely reduced.

B. *Dog Aortas*

A summary of the protocols for aerobic metabolism studies on 12 samples of dog aortas is given in table 11.

I. *Respiration*

1. General.—As was the case with the human arterial samples, the Q_{O_2} values of the dog aortas tended to decrease when the samples were maintained in buffer medium at 37 C. This behavior of the tissue respiration is apparent from the initial course of the curves in figure 11.

2. Initial Respiration Values.—The maximal initial Q_{O_2} value observed in the experiments on dog aortas was 0.63. In conformity with the data obtained on the human samples the respiration of the dog aortas showed a tendency to decrease with time elapsed after death.

3. Respiration Values After Prolonged Storage of Samples at 4 C.—Determinations

TABLE 11. SUMMARY OF PROTOCOLS FOR AEROBIC EXPERIMENTS ON 12 INTACT DOG AORTIC SAMPLES (INTIMA-MEDIA PREPARATIONS).

Sample No.	Time After Death		Period	Minutes	Q_{O_2}	R. Q.	$Q_g^{O_2}$
	Days	Hours					
1	0	4	1	107	0.435	0.83	0.386
			2	83	0.305	0.99	0.532
			3	135	0.246	1.11	0.287
2	0	3	1	116	0.227	1.07	0.455
	1	0	1	83	0.116	0.64	0.200
			2	337	0.118	0.81	0.252
3	0	3½	1	169	0.219	0.89	0.362
			2	104	0.152	0.91	0.344
	1	1	1	286	0.084	1.33	
4	0	2½	1	185	0.125	1.15	0.766
	1	2	1	95	0.139	1.04	0.375
			2	78	0.156	0.82	
	3	1	1	134	0.178	0.83	0.588
			2	70	0.092	1.11	
	5	0	1	94	0.145	0.70	0.428
			2	53	0.119	0.92	
	18	3	1	180	0.030	1.16	0.172
5	0	3	1	38	0.117	1.72	0.918
			2	27	0.121	0.86	0.474
			3	32	0.112	1.08	0.215
			4	26	0.144	0.56	0.265
	1	2	1	82	0.057	0.44	0.141
			2	98	0.059	0.98	
	3	0	1	137	0.061	0.78	0.052
			2	65	0.059	0.89	
	5	0	1	89	0.059	0.32	0.193
			2	69	0.035	0.84	0.217
	21	4	1	188	0.033	0.60	0.117
6	0	2½	1	134	0.246	1.02	0.565
			2	68	0.198	1.11	0.448
			3	50	0.179	1.06	0.608
	1	0	1	73	0.183	0.73	0.351
			2	184	0.154	0.98	0.302
7	0	1¼	1	63	0.626	0.56	1.055
			2	67	0.336	1.13	
			3	51	0.378	0.98	
			4	24	0.360	1.03	
	1	0	1	56	0.287	0.59	0.696
8	0	1½	1	29	0.425	0.54	0.660
			2	61	0.269	1.07	0.340
			3	71	0.212	0.98	0.440
	0	7	1	65	0.180	1.11	0.440
			2	60	0.151	1.06	0.346
	1	1	1	99	0.149	0.48	0.315
			2	73	0.151	0.98	0.266
	5	0	1	77	0.178	0.78	0.405
			2	55	0.105	1.16	0.415

TABLE 11—Continued

Sample No.	Time After Death		Period	Minutes	Q^{o_2}	R. Q.	$Q_g^{o_2}$
	Days	Hours					
(8)	11	0	1	155	0.072	1.23	0.572
			2	152	0.097	1.08	0.242
	18	0	1	155	0.100	0.45	
9	0	5	1	42	0.239	1.30	0.189
			2	50	0.154	1.09	0.542
			3	67	0.190	0.83	0.215
	1	2	1	93	0.132	0.95	0.318
			2	76	0.166	1.14	0.273
	7	0	1	164	0.121	0.86	0.177
			2	205	0.132	0.96	0.420
10	0	1¼	1	172	0.195	0.75	0.895
			2	167	0.058	0.86	
	1	7	1	108	0.188	1.19	0.192
			2	64	0.103	0.73	0.485
	5	0	1	104	0.144	0.74	0.058
			2	119	0.124	0.73	
11	0	2	1	32	0.543	1.01	0.809
			2	85	0.337	1.44	0.444
			3	99	0.293	0.77	0.381
			4	71	0.188	0.96	0.442
	1	1	1	115	0.209	0.92	0.234
			2	173	0.165	1.00	0.095
	4	1	1	187	0.204	0.92	0.239
			2	202	0.160	1.10	0.185
12	0	1¾	1	57	0.111	1.28	0.397
			2	114	0.106	0.93	0.151
	1	3	1	140	0.091	0.89	0.150
			2	84	0.060	1.13	0.443
	6	0	1	170	0.061	0.62	0.154
			2	179	0.048	0.94	0.114

of the respiratory rate of 10 aortic samples, stored in the refrigerator at 4 C. for periods of days or weeks, showed a definite tendency for the Q_{o_2} values to decrease with time. As seen from table 11 and figure 11, some of the samples were able to maintain a notable rate of respiration for several days. Three samples (No. 4, 5, and 8), examined 18 to 21 days after death, still showed a definite oxygen consumption.

4. Comparison of the Respiratory Rates of the Aortic Intima, Media, and Intact Intima-Media.—Comparative determinations of the respiratory rates of the isolated intima, media, and intact intima-media from 1 dog aorta (No. 10), carried out 1¼ hours after death showed Q_{o_2} values of 0.252, 0.192, and 0.195, respectively.

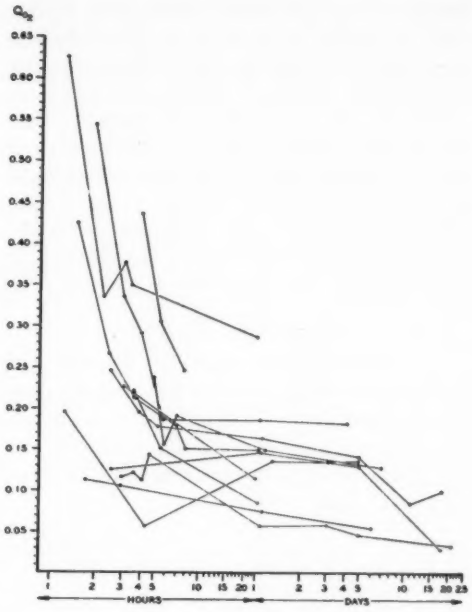

FIG. 11. Effect of prolonged storage at 4 C. (and intermittent determination of metabolism at 37 C.) on Q_{o_2} values of dog aortas. Logarithmic scale used for the abscissa.

II. *Respiratory Quotient*

The mean initial respiratory quotient of the 12 dog aortic samples was 0.99 (s. d. of distri-

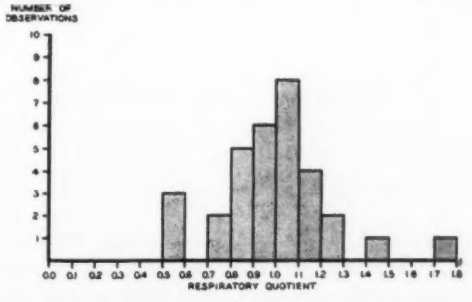

FIG. 12. Histogram illustrating the distribution of R.Q. values as observed in 32 experimental periods in initial experiments on 12 dog aortic samples. Mean value of determinations, 0.99.

bution 0.24). A histogram illustrating the distribution of the R. Q. values as observed in 32 experimental periods in initial experiments on the 12 aortic samples is presented in figure 12.

Determinations of the respiratory quotient of 10 aortic samples stored in the refrigerator at 4 C. showed a decline of the quotient from an original mean value of 1.01 to an average value of 0.86 after 24 to 30 hours of storage. After 5 and 20 days of storage the mean R. Q. of the samples was, respectively, 0.76 and 0.80.

III. *Aerobic Glycolysis*

1. General.—The tendency for the $Q_g^{O_2}$ values of the aortic tissue to decrease when the samples were maintained at 37 C., which was found in the case of the human samples, was also observed for the dog aortas (see table 11 and initial part of figure 13).

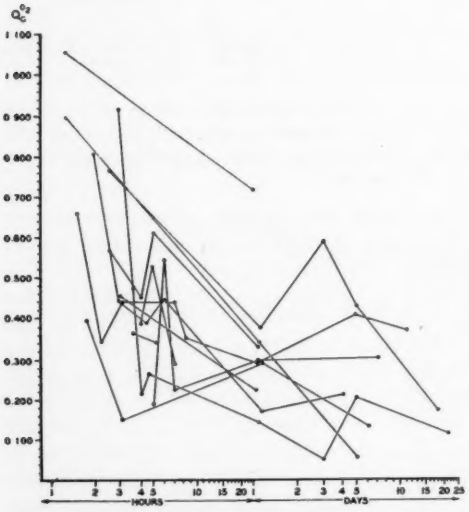

FIG. 13. Effect of prolonged storage at 4 C. (and intermittent determination of metabolism at 37 C.) on $Q_g^{O_2}$ values of dog aortas. Logarithmic scale used for the abscissa.

2. Initial Glycolysis Values.—The maximal $Q_g^{O_2}$ value measured for the dog aortas was 1.055, a value similar to that observed for the human samples. The mean $Q_g^{O_2}$ value for samples examined within 1½ hours after death was 0.870 (range 0.660 to 1.055), for samples examined between 1½ and 2½ hours after death, 0.634, and for samples examined between 3 and 5 hours after death, 0.513.

3. $Q_g^{O_2}$ Values After Prolonged Storage of Samples at 4 C.—Measurements of the rate of aerobic glycolysis were carried out on 10 aortic samples stored in the refrigerator at 4 C. for periods of days or weeks. The results, presented in table 11 and figure 13, show a significant decrease of the glycolysis rate with time.

4. Comparison of Aerobic Glycolysis Rates of the Intima, Media, and Intact Intima-Media.—Parallel determinations of the aerobic glycolysis rates of the isolated intima, media, and intact intima-media from the same aorta (8 experimental periods) showed mean $Q_g^{O_2}$ values of 0.418, 0.300, and 0.598, respectively.

5. Glucose Utilization.—Determinations of the amounts of glucose which disappeared from the glucose containing medium during the aerobic experiments were carried out on 10 dog aortas (table 12). The average amount of glucose which disappeared from the medium during the initial experiments was 6.7 mg./1000 mg. dry tissue/hour. It will be seen from the table that in 7 out of the 10 initial experiments more glucose disappeared from the medium than could be accounted for by the simultaneously determined tissue respiration and glycolysis. In the remaining 3 experiments more glucose was utilized than corresponding to the observed changes in the glucose content of the medium. The average balance for the 10 experiments was + 3.4 mg. glucose/1000 mg. dry tissue/hour.

Parallel determinations on the glucose balance were further made in 9 experimental periods on the isolated intima, media, and intact intima-media from the same aorta (No. 10). The measurements showed that an average of 3.6, 5.8, and 4.1 mg. of glucose, respectively, disappeared from the medium per 1000 mg. dry tissue per hour for the 3 preparations. The corresponding glucose balances were + 1.8, + 4.6, and + 1.8 mg./1000 mg. dry tissue/hour.

TABLE 12. GLUCOSE UTILIZATION AND GLUCOSE BALANCE BY INTACT INTIMA-MEDIA PREPARATIONS OF 10 DOG AORTAS UNDER AEROBIC CONDITIONS.

Sample No.	Time After Death (Hours)	Period (Minutes)	Glucose Disappeared	Glucose Accounted for Through Combustion and Glycolysis	Balance
			Mg. Glucose/1000 Mg. Dry Tissue/Hour		
3	3.5	273	3.8	1.7	+2.1
4	2.5	185	9.4	3.2	+6.2
	26	95	5.1	1.8	+3.3
	73	134	3.5	2.5	+1.0
	120	94	6.4	1.9	+4.5
	432	180	0.9	0.7	+0.2
5	3	123	22.4	2.2	+22.2
	72	137	7.2	0.3	+6.9
	120	158	8.8	0.9	+7.9
	508	188	2.8	0.5	+2.3
6	2.5	252	1.9	2.5	−0.6
	24	257	1.0	1.5	−0.5
7	1.4	63	2.7	5.0	−2.3
8	1.5	161	5.9	2.0	+3.9
	7	125	1.9	1.1	+0.8
	25	172	5.3	1.4	+3.9
	120	132	3.6	1.8	+1.8
	432	155	5.3	3.5	+1.8
9	6	159	11.6	1.5	+10.1
	26	169	7.3	1.4	+5.9
	168	369	−1.2	1.5	−2.7
10	1.3	172	−4.0	3.9	−7.9
	31	172	10.2	1.5	+8.7
	120	104	6.0	1.4	+4.6
11	1.8	287	4.0	2.3	+1.7
	25	288	0.6	0.5	+0.1
	97	389	2.3	1.1	+1.2
12	1.8	171	9.9	1.1	+8.8
	27	224	0.6	1.1	−0.5
	144	349	1.4	0.6	+0.8

6. Energy Production Through Tissue Respiration and Glycolysis.—In initial experiments on 12 dog aortas the respiration was found to contribute an average of 61 per cent (s. d. of distribution 11.6) and the glycolysis an average of 39 per cent of the total energy production by the tissue. A histogram illustrating the distribution of the percentage contribution of the respiration to the total energy production by the tissue as observed in 30 experimental periods in initial experiments on the 12 dog aortas is presented in figure 14. Investigations performed on samples after storage at 4 C. showed that the mean energy production contributed by the tissue respiration after 1, 2, 3, 4, 5, 6, and 7 days valued, respectively, 64, 66, 67, 65, 60, 54, and 53 per cent.

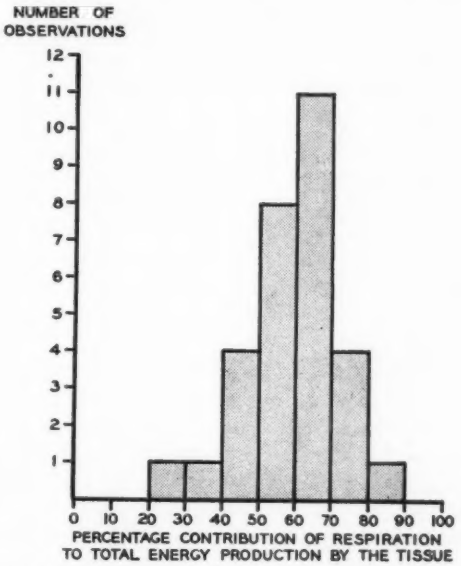

FIG. 14. Histogram illustrating the distribution of the percentage contribution of the respiration to the total energy production by the tissue as observed in 30 experimental periods in initial experiments on 12 dog aortic samples. Mean value of determinations, 61 per cent.

IV. *Anaerobic Glycolysis*

A summary of the protocols for anaerobic metabolism studies on 5 samples of dog aortas is given in table 13.

1. Initial Glycolysis Values.—The mean initial glycolysis value for the 5 aortic samples was 0.630 (range 0.158 to 1.000) and the maximal value observed in a single experimental period 1.970.

2. $Q_g^{N_2}$ Values After Prolonged Storage of Samples at 4 C.—Measurements of the rate of anaerobic glycolysis were carried out on 2 aortic samples stored in the refrigerator at 4 C.

TABLE 13. SUMMARY OF PROTOCOLS FOR ANAEROBIC EXPERIMENTS ON 5 INTACT DOG AORTIC SAMPLES (INTIMA-MEDIA PREPARATIONS).

Sample No.	Time After Death		Period	Minutes	$Q_g^{n_2}$
	Days	Hours			
2	0	3	1	262	0.590
			2	72	1.970
6	0	4	1	70	0.875
			2	48	0.815
			3	61	0.790
7	0	2	1	67	0.612
			2	60	1.435
11	0	3	1	64	0.803
			2	81	0.582
			3	112	0.618
			4	65	0.250
	1	1	1	89	0.282
			2	194	0.283
	4	1	1	183	0.240
			2	209	0.215
	11	1	1	191	0.240
			2	180	0.187
	39	2	1	314	0.102
12	0	2¼	1	158	0.114
			2	122	0.216
	1	4	1	137	0.247
			2	84	0.254
	6	0	1	162	0.167
			2	179	0.163
	31	0	1	109	0.055
			2	227	0.038

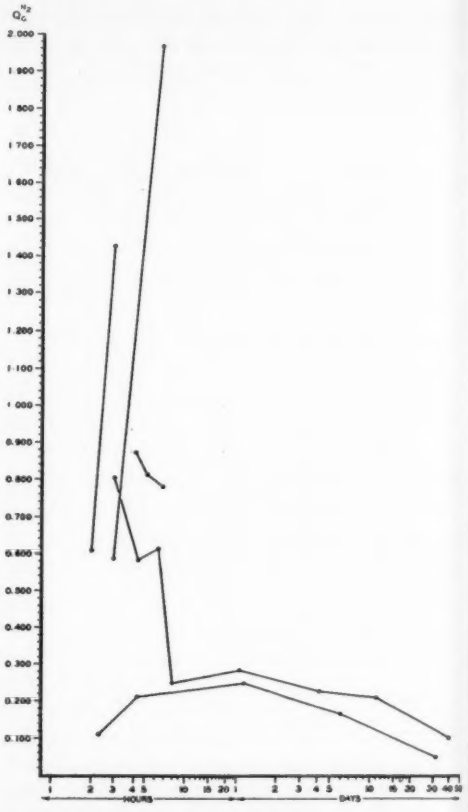

FIG. 15. Effect of prolonged storage at 4 C. (and intermittent determination of metabolism at 37 C.) on $Q_g^{n_2}$ values of dog aortas. Logarithmic scale used for the abscissa.

for periods of days or weeks. The results, presented in table 13 and figure 15, reveal a similar tendency for the $Q_g^{n_2}$ values to decrease with time as was observed for the respiration and the aerobic glycolysis.

3. Comparison of Parallel Determinations of Aerobic and Anaerobic Glycolysis Rates.—Parallel determinations of the aerobic and anaerobic rates of glycolysis were carried out on samples from the same aorta in 10 experiments. The measurements showed a high degree of correlation between the determinations, the coefficient of correlation $Q_g^{o_2}/Q_g^{n_2}$ being $+0.82$ ($t = 4.03$, N: 10). The rate of anaerobic glycolysis was on the average 27 per cent higher than the rate of aerobic glycolysis. The results of the parallel determinations are presented in table 14.

4. Glucose Utilization.—Measurements of the amounts of glucose which disappeared from the glucose containing medium during the anaerobic experiments were performed on 4 dog aortas (table 15). The average amount of glucose which disappeared during the initial experiments on the samples was 6.0 mg./1000 dry tissue/hour, and the average balance + 4.5 mg. glucose/1000 mg. dry tissue/hour.

DISCUSSION

The highest Q_{o_2} values observed in the present study for human and dog aortic tissue

TABLE 14. PARALLEL DETERMINATIONS OF AEROBIC AND ANAEROBIC RATES OF GLYCOLYSIS (DOG AORTAS)

$Q_g^{O_2}$	$Q_g^{N_2}$
0.017	0.044
0.129	0.165
0.137	0.283
0.211	0.228
0.234	0.158
0.260	0.249
0.445	0.890
0.461	0.573
0.542	0.830
1.055	1.000

were, respectively, 0.365 and 0.626, and the maximal $Q_g^{O_2}$ values 1.120 and 1.055. How closely these values approach the respiratory and glycolysis rates of the aortic tissue in vivo is difficult to decide. It should be emphasized, however, that in the case of the dog aortas the samples were chilled as early as 15 minutes after the death of the animals, the 15 minutes representing the approximate time required for the sterile removal of the artery from the body. Since the decrease in respiration and glycolysis which takes place at low temperature is only moderate, the values found in the dog experiments may be expected to be as representative of the actual tissue metabolism as usual in vitro studies on isolated tissues. It should be recalled, however, that a negative correlation was observed also in the case of the dog samples between the time elapsed after removal of the artery and the initial Q_{O_2} and $Q_g^{O_2}$ values. For this reason the measurements obtained the shortest time after death must be given most importance. It is reasonable to assume that the variations observed between initial Q_{O_2} and $Q_g^{O_2}$ values for aortic samples from different dogs at least partly may be due to the influence of the anesthetic used and to differences in breed.

TABLE 15. GLUCOSE UTILIZATION AND GLUCOSE BALANCE BY INTACT INTIMA-MEDIA PREPARATIONS OF 4 DOG AORTAS UNDER ANAEROBIC CONDITIONS.

Sample No.	Time After Death (Hours)	Period (Minutes)	Glucose Disappeared	Lactic Acid Formed	Balance
			Mg./ 1000 Mg. Dry Tissue/ Hour		
6	4	179	15.2	3.3	+11.9
7	2	127	5.9	4.0	+ 1.9
11	2.9	322	1.5	2.3	− 0.8
	25	283	1.8	1.1	+ 0.7
	98	392	1.4	0.9	+ 0.5
12	2.3	280	1.5	0.6	+ 0.9
	28	221	6.0	1.0	+ 5.0
	144	341	1.5	0.7	+ 0.8

Since a longer time passed between the death of the human individuals and the chilling of the samples after removal of the artery at autopsy, the initial metabolism values obtained on human aortas in the present study may deviate notably from determinations performed on samples removed immediately after death. In most instances at least one hour elapsed from the moment of death until the body was placed in the refrigerator of the morgue. Furthermore, because of the protected position of the aorta in the body the cooling of the artery in situ proceeds slowly. After removal of the aorta at autopsy and placement of the sample in a beaker immersed in crushed ice the decline in respiratory and glycolytic capacity by the tissue, as shown in figures 1 and 6, may be expected to be only small. Since the period in which the samples from the removal at autopsy to their placement in 37 C. warm buffer on the average was about 75 minutes, this time should be subtracted from the time statements listed in table 1 in order to arrive at the period during which the tissue before analysis was subjected to the influences of unknown temperature and degree of anoxemia. If such time corrections are applied it will be seen that in the case of samples No. 3, 14, and 24, not more than 135, 135, and 60 minutes elapsed from the death of the individuals to the start of the first experimental period. The Q_{O_2} values for these samples were, respectively, 0.365, 0.234, and 0.217, and the $Q_g^{O_2}$ values 1.070, 0.685, and 0.904.

An interesting feature, common to both hu-

man and dog aortic tissue, is the relative independence of the glycolysis rate on the oxygen tension. Thus the mean anaerobic glycolysis rate for the human samples was only 30 per cent, and for the dog aortas 27 per cent higher than the simultaneously determined aerobic glycolysis. This metabolic characteristic places the aorta in the same group of tissues as the retina, the jejunal mucosa, and some tumors (10, 26, 27, 28).

Another significant finding is the magnitude of the aerobic glycolysis as compared with the oxygen consumption by the tissue. The importance of the glycolysis for the tissue metabolism is clearly evident from the fact that the glycolysis, in the case of the human aortas, on the average was responsible for 51 per cent of the total energy production by the tissue. For the dog aortas the contribution was somewhat smaller, 39 per cent, but must still be considered as very appreciable. As outlined in a recent publication (14) it is possible that the function of the carbonic anhydrase in the human aortic wall is associated with the high aerobic glycolysis rate of the tissue.

The investigation failed to reveal any correlation between the age of the individuals and the initial Q_{o_2} and Q_g^{o2} values of the tissue. Because of the many extraneous factors which may have influenced the original metabolic values and which in the present study were outside of the control of the investigators, the finding cannot be considered as conclusive. The moderate positive correlations observed between the cholesterol content of the tissue and the R. Q. values and between the total lipid content and the R. Q. values deserve mentioning. Although according to the present concepts (23) great caution must be exerted with regard to conclusions drawn from R. Q. values in tissue experiments—a caution which in the present study is further warranted because of the variation in R. Q. values observed between individual periods of the same experiment—the correlations might suggest a tendency to conversion of carbohydrate to fat by the tissue samples.

The fact that it was possible to demonstrate a notable respiration and glycolysis by aortic samples stored at 4 C. for periods of several days or weeks possibly represents a characteristic feature of slowly metabolizing tissues. These observations are in agreement with the findings by Hiertonn (11) on the respiration of stored dog aortas. The demonstration through the present metabolic studies of a long viability of the aortic tissue likewise conforms well with the findings on human and dog aortas by Peirce, Gross, Bill, and Merrill (19) who were able to obtain growth of fibroblasts in tissue cultures from segments of aortas stored for periods of 30 and 50 days at 4 C. in a salt solution-serum medium.

Summary

A study was made of the rate of respiration and rates of aerobic and anaerobic glycolysis by segments of human and dog aortas maintained under sterile conditions.

The maximal initial Q_{o_2}, Q_g^{o2}, and Q_g^{n2} values of the human aortas were 0.365, 1.120, and 0.900, and of the dog aortas 0.626, 1.055, and 1.970. The respiration and glycolysis usually decreased quickly when the samples were maintained at 37 C.; at 4 C. the decrease in metabolism was considerably slower. In most instances respiration and glycolysis were still measurable after storage of the samples at 4 C. for periods of several weeks.

Both human and dog aortic tissue are characterized by a relative independence of the glycolysis on the oxygen tension, the anaerobic glycolysis rates being on the average only 30 and 27 per cent higher than the simultaneously determined aerobic glycolysis.

The aerobic glycolysis by the human aortic samples accounted on the average for 51 per cent, and by the dog aortas for 39 per cent of the total energy production by the tissue.

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STUDIES IN PASSIVE TRANSFER OF SKIN SENSITIZING ANTIBODIES (ATOPIC REAGINS) TO THE SKIN OF YOUNG AND OLD INDIVIDUALS

Difference in Size of Wheal Between Young and Old Individuals and Between Men and Women

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THE existence of circulating antibodies in the blood of certain allergic individuals was first demonstrated in 1921 by Prausnitz and Küstner (9) by the technique which now bears their name. The principle of the Prausnitz-Küstner test is as follows: Serum from the allergic individual A is injected intracutaneously into a normal, non-allergic person B. Twenty-four hours later the allergen to which A is allergic is injected into the same spot of B's skin, and, as a control, into another part of the skin of person B. A positive reaction, proving the existence of antibodies in A's serum, will appear in the course of twenty minutes as a typical urticarial wheal surrounded by erythema. The control injection should not show any wheal or erythema.

Circulating antibodies (which some authors now call atopic reagins) have been demonstrated in individuals with various allergic diseases, especially the so-called atopic diseases (asthma, hay fever, vasomotor rhinitis, and Besnier's prurigo). These antibodies are thermolabile and have a conspicuous affinity for the dermal cells: A Prausnitz-Küstner reaction may be elicited more than a month after the injection of the antibody into the skin.

Only a few investigations have been made into the question of the susceptibility of the skin of normal, non-allergic individuals as receptor and reacting organ for the circulating antibodies. Coca and Grove (1) found that out of 103 presumably normal persons, only 86 (84 per cent) would give a positive Prausnitz-Küstner reaction. Walzer (10), using oral administration of the antigen, believed that some of the persons, not giving a positive skin reaction, were "poor receptors" as to the ability of the skin to fix the antibody and react with the corresponding antigen.

The influence of age upon the skin reactions in the Prausnitz-Küstner test does not seem to have been investigated before. Below the author will report a study of this aspect and discuss variations found in the size of the wheal induced by the passive transfer to males and females.

MATERIALS AND METHODS

The serum used in this investigation was produced in 1945 by the State Serum Institute, Copenhagen, Denmark, as a dried serum from the pooled sera of 14 grass-hay fever patients; 500 ml. of blood was drawn from each patient. Despite six years' storage, the activity of the grass-pollen antibody had not diminished.

The dried serum was readily soluble in 0.9 per cent saline, and with this the following sterile serum solutions were made:

1. 10 per cent serum solution
2. 1 per cent serum solution
3. 0.5 per cent serum solution
4. 0.2 per cent serum solution
5. 0.1 per cent serum solution

The solutions were stored in the refrigerator and discarded when they were 8 days old. Fresh solutions were prepared from 10 per cent serum solutions stored in the frozen state.

The antigen used throughout was Timothy extract prepared by Coca's method; an extract of 1000 nitrogen units per milliliter was used. All injections were made with tuberculin syringes and 26-gauge needles. Separate syringes were used for each of the 5 serum dilutions and the Timothy extract.

In all cases the skin on the anterior aspect of the forearm was used. The 5 serum dilu-

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tions were injected along the midline of the arm, 2 cm. apart; 0.1 ml. was injected into each site, the strongest serum solution most proximal. Twenty-four hours later, nothing but faint tiny red spots (from the penetration of the needles) remained to be seen on the skin. At this time 0.05 ml. of the Timothy extract was injected directly into each of the 5 sensitized skin sites. Twenty minutes later the skin reactions were read, the transverse diameter of the urticarial wheals being measured by means of a plastic ruler and recorded. The erythematous component of the reaction was so irregular and ill-defined that the measurement could not be exact. When there was no sign of an actual wheal or erythema, but only some nodulous remnants of the small Timothy injection, the reaction was recorded as negative.

The subjects totalled 110 persons, 54 men and 56 women, ranging in age from 18 to 96 years. The older individuals were residents of the St. Louis City Infirmary Hospital, while the younger ones were partly students and partly employees of the institution. No person with skin disease was included in the study.

Results

The results of the Prausnitz-Küstner reactions with the 5 different antibody (serum) dilutions are given for each of the 110 persons in the study in table 1 (subjects ≦ 59 years

Table 1. Diameter (in Mm.) of the Urticarial Wheal after Passive Transfer with Different Timothy-Antibody Concentrations in 23 Men and 29 Women ≦ 59 Years Old

23 Men						29 Women					
Age	Serum (Antibody) Dilution					Age	Serum (Antibody) Dilution				
	10%	1%	0.5%	0.2%	0.1%		10%	1%	0.5%	0.2%	0.1%
36	15	11	6	4	0	25	11	9	8	5	0
37	12	9	8	4	0	55	11	9	7	0	0
32	10	7	7	0	0	24	13	8	7	6	0
53	11	6	4	0	0	22	12	7	5	0	0
58	17	10	5	0	0	52	11	9	6	0	0
24	11	8	5	0	0	35	12	9	6	0	0
43	13	8	4	0	0	23	11	8	7	0	0
57	12	6	0	0	0	34	13	10	7	0	0
27	9	8	0	0	0	37	11	7	0	0	0
26	11	8	6	0	0	23	12	7	6	0	0
21	12	8	6	0	0	50	14	9	7	0	0
29	16	9	7	4	0	30	14	10	8	5	0
27	13	10	6	0	0	59	8	6	5	0	0
25	12	10	7	7	0	36	12	7	6	4	0
29	10	6	4	0	0	58	16	10	7	0	0
26	9	6	0	0	0	54	12	9	7	5	0
21	9	6	4	0	0	25	13	10	6	4	0
19	12	7	6	0	0	18	12	8	7	0	0
42	14	9	8	6	0	25	12	9	9	8	6
52	10	7	0	0	0	23	12	9	9	5	0
59	11	8	6	0	0	24	10	9	4	0	0
36	8	0	0	0	0	22	11	9	6	4	3
48	11	6	0	0	0	53	12	8	5	0	0
Mean age 34.6 yrs.						56	16	10	7	0	0
						22	10	9	5	0	0
						57	14	11	8	6	0
						35	9	8	5	4	0
						33	13	6	6	5	0
						32	15	9	5	0	0
						Mean age 35.8 yrs.					

TABLE 2. DIAMETER (IN MM.) OF THE URTICARIAL WHEAL AFTER PASSIVE TRANSFER WITH DIFFERENT TIMOTHY-ANTIBODY CONCENTRATIONS IN 31 MEN AND 27 WOMEN $\geq$ 60 YEARS OLD.

31 Men						27 Women					
Age	Serum (Antibody) Dilution					Age	Serum (Antibody) Dilution				
	10%	1%	0.5%	0.2%	0.1%		10%	1%	0.5%	0.2%	0.1%
73	10	0	0	0	0	76	14	6	0	0	0
80	9	3	0	0	0	69	13	5	0	0	0
70	12	9	6	0	0	71	16	9	7	0	0
67	11	6	0	0	0	78	14	10	9	4	0
66	10	4	0	0	0	72	16	10	9	0	0
74	11	3	0	0	0	74	11	9	5	0	0
80	11	7	4	0	0	68	11	8	0	0	0
85	12	6	0	0	0	70	9	6	0	0	0
85	12	0	0	0	0	80	14	9	6	0	0
84	14	9	8	0	0	79	13	7	6	0	0
75	14	11	9	0	0	77	14	8	6	0	0
88	12	0	0	0	0	75	15	9	6	0	0
84	16	12	8	0	0	70	14	11	6	5	0
83	14	11	8	0	0	77	16	10	8	6	0
78	12	9	5	0	0	80	20	16	11	8	0
79	12	9	7	0	0	76	15	9	6	5	0
87	13	9	4	0	0	76	14	8	5	0	0
69	17	8	5	0	0	63	12	7	5	0	0
81	13	10	9	4	0	66	13	11	10	6	0
69	17	8	7	7	0	82	17	9	7	0	0
71	15	8	6	0	0	82	13	9	7	0	0
68	9	4	0	0	0	86	16	10	9	7	0
72	14	10	6	0	0	87	13	11	4	0	0
89	13	4	0	0	0	83	12	9	6	0	0
61	14	6	0	0	0	88	17	10	7	0	0
80	11	7	0	0	0	76	13	7	4	0	0
94	12	7	0	0	0	85	12	6	0	0	0
82	13	8	7	0	0	Mean age					
81	16	6	5	0	0	76.7 yrs.					
96	16	12	10	0	0						
Mean age											
78.4 yrs.											

old) and table 2 (subjects $\geqq$ 60 years old). For each of the 5 antibody concentrations, the diameter of the wheal produced by the antigen-antibody reaction is recorded. Men and women are considered separately, as women—unexpectedly—proved to give significantly more marked reactions than men. This phenomenon, which does not seem to have been described previously, will be discussed later.

From table 1 and 2 it will be seen that the individual variations are rather marked. It will be seen, however, that no person failed to react with the strongest antibody concentration, and only 4 out of 110 did not react with the 10 times weaker concentration. The previously described "poor receptors" are probably very scarce when a circulating skin-sensitizing antibody with a high titer is used as in this study. A slight variation in the diameter (or radius) of the approximately circular wheal means a bigger variation in the area of the wheal $\left(\text{area} = \left(\frac{\text{diameter}}{2}\right)^2 \times \Pi\right)$. Accordingly, we calculated for each wheal recorded in tables 1 and 2 the figures: $\left(\frac{\text{diameter}}{2}\right)^2$ as this will give a better measure for the variations in the size of the wheals.

1. Difference Between Young and Old In-

dividuals.—Figures 1 and 2 give the mean values of $\left(\frac{\text{diameter}}{2}\right)^2$ (ordinate) for each of the 5 antibody concentrations (abscissa). Figure 1 sets out the values for young and old women, figure 2 for young and old men. For each of the corresponding 5 mean values of $\left(\frac{\text{diameter}}{2}\right)^2$ a t-test[1] was performed to determine whether any difference between young and old individuals could be considered significant. The t-values are given in the figures.

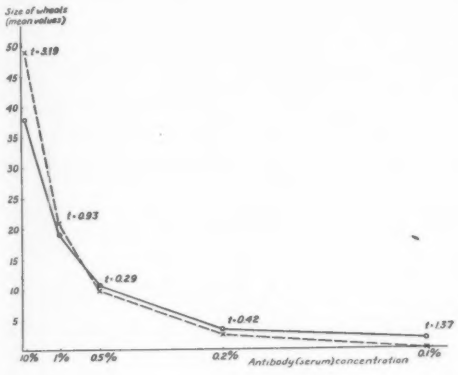

FIG. 1. Mean values of $\left[\frac{\text{Diameter}}{2}\right]^2$ for wheals induced by passive transfer of atopic hay fever reagin in 5 different concentrations in young and old women. x— — — — — — — —x 27 women ≥ 60 years old. o————————o 29 women ≤ 59 years old.

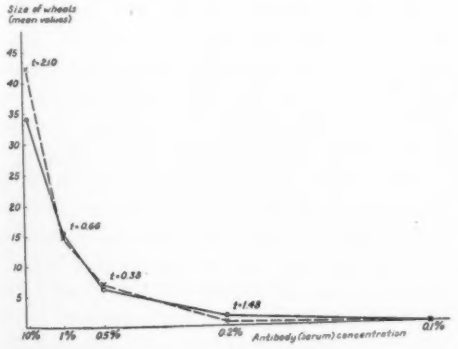

FIG. 2. Mean values of $\left[\frac{\text{Diameter}}{2}\right]^2$ for wheals induced by passive transfer of atopic hay fever reagin in 5 different concentrations in young and old men. x— — — — — — — —x 31 men ≥ 60 years old. o————————o 23 men ≤ 59 years old.

It is clear from figures 1 and 2 that the strongest antibody (serum) concentration gives a significantly larger wheal in the passive transfer test in old than in young individuals. This applies to men as well as to women. There are no significant differences for the 4 weaker antibody dilutions.

At first this result would seem to be contrary to expectations, considering the thinner and more delicate skin of old people. The explanation is probably to be sought in the blood circulation of the skin. It is known that the antigen-antibody reaction releases histamine (or H-substance) which is presumably responsible for the dilatation of the blood vessels with exudation which gives rise to the wheal. It is further an established fact that if the blood supply to the skin is decreased, the liberated histamine may be able to act for a longer time (and penetrate further) before it is carried away by the blood, and a larger wheal will result (8).

In the present experiment, the finding of a larger wheal in old than in young individuals could be explained by assuming that the blood supply to the skin is diminished in old age. This explanation is in fact in complete agreement with the finding of Friedell and his associates (4). Studying the circulation time by means of radiophosphorus (P^{32}), they demonstrated that the rate of diffusion of P^{32} into the tissues is higher in older persons. The authors offer the suggestion that in arteriosclerosis and in old age capillary dilatation with stasis is always present.

It should be mentioned that an investigation into passive skin sensitization of young and old guinea pigs showed a result opposite to our findings: decreased reactions in older animals, compared to younger ones (5). Chase (2) reports, however, that saline "blebs" deposited in

[1] t-test: $\frac{\text{Difference between averages}}{\text{Standard error of difference}}$

the skin of old guinea pigs do not recede as rapidly as in the skin of younger animals. Moreover, the same author (3) found that certain erythematous reactions readily induced in the skin of young guinea pigs appeared only slightly, if at all, in the skin of old guinea pigs after intravenous injection of the antigen in small amounts. The two last-mentioned experiments—together with Friedell's findings—seem to point in the same direction as our results and may be explained by a diminished blood supply to the skin in older individuals. That the difference between young and old individuals could only be found with the strongest antibody concentration may presumably be explained by the amounts of liberated histamine (H-substance). As a matter of fact, the young persons proved to be somewhat better recipients for the passive transfer measured by the number of positive reactions with the weaker antibody concentrations (tables 1 and 2).

Our study has only indirect bearing on the problem of skin testing in allergic individuals of various age groups. The skin reaction in these cases is an expression of the "naturally" deposited antibody in the skin, and the size of the skin reaction will be determined, not only by the age of the individual, but probably much more so by the amount of antibody present. Moreover, both old and young people may be sensitized to a high or low degree.

2. Difference Between Men and Women.—As mentioned above, it was incidentally found that women gave stronger skin reactions than men. This phenomenon, which, as far as we know, has not been described previously, may be of some interest to allergists in their interpretation of skin tests. Besides, it is of general interest concerning the biology of the skin in the two sexes.

In figure 3 the mean values of $\left(\frac{\text{diameter}}{2}\right)^2$ are given for the 54 men and 56 women in the study. It is evident that to all 5 antibody (serum) concentrations women respond by a larger wheal than men. This difference is statistically significant for the 1 per cent, 0.5 per cent, and 0.2 per cent solutions, and considerable (but not significant) for the 10 per cent and 0.1 per cent solutions.

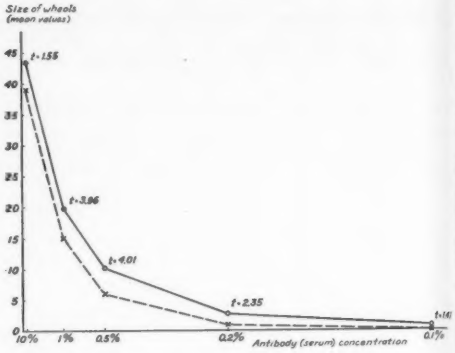

FIG. 3. Mean values of $\left[\frac{\text{Diameter}}{2}\right]^2$ for wheals induced by passive transfer of atopic hay fever reagin in 5 different concentrations in men and women.
x— — — — — — — —x 54 men.
o————————————o 56 women.

Two possibilities suggest themselves in explanation of this phenomenon: 1) a difference between the two sexes in the amount (or composition) of urticariogenic substances liberated from the antigen-antibody reaction, or; 2) a difference in the physical properties (elasticity) of the skin of men and women.

The first possibility does not seem very likely. One might then expect to find the maximum difference with the largest amount of antibody, and the difference would have to decline with falling doses of antibody. As will be seen from the figure this is not the case.

The second possibility, that we have simply recorded a greater elasticity in the skin of women than of men, must then be considered. The finding that the sex difference appears with all 5 serum dilutions would fit with this explanation. If women have a more elastic skin than men, any wheal must be expected to become slightly larger in women—irrespective of the antibody concentration.

In the literature there are, as far as we know, no reports on sex differences in the elasticity of the skin. However, in a paper dealing with measurements of the elastic properties of the skin and subcutaneous tissue in young and

old individuals Kirk and Kvorning (6) reported their findings for each individual investigated. From the figures given there, a sex difference is easily recognized in the "primary indentation" of the skin as measured by Schade's elastometer. This "primary indentation" is significantly greater in women than in men in the group of young individuals (t-value 4.93), and considerably greater in the group of old individuals (t-value 1.66). The latter group, however, contains only 5 women against 23 men.

In a later study by Kirk and Chieffi (7), using the same technique on 77 men and 112 women between the ages of 25 and 59 years, this difference in the indentation of the skin between men and women could again be demonstrated. The values for the absolute indentation expressed in millimeters are listed in table 3. It will be seen from the data that the primary indentation is significantly greater in the women than in the men (t-tests performed by the present author).

These investigations would explain why an urticariogenic wheal in the skin — *ceteris paribus*—will tend to become larger in women.

The measurements with Schade's apparatus records simultaneously the elasticity of skin and subcutaneous tissue. A wheal, on the other hand, involves only the skin proper. The present investigation demonstrates that a sex difference can be found in the skin (epidermis + dermis) alone. The possibility remains, however, that there is also a sex variation in the elasticity of the subcutaneous tissue.

Table 3. The Primary Indentation in Men and Women of Various Ages as Measured with Schade's Elastometer (J. E. Kirk and M. Chieffi).[1]

Age Groups Years	Men		Women		Significance of Difference (t-Test)
	Number	Indentation in Mm.	Number	Indentation in Mm.	
25-34	21	2.49	27	2.75	0.76
35-44	26	2.27	36	3.23	3.39[2]
45-59	30	1.99	49	3.10	3.31[2]
25-59	77	2.23	112	3.06	5.05[2]

[1] This material was kindly placed at our disposal by J. E. Kirk and M. Chieffi.
[2] Significant at 0.1% level of confidence.

Summary

Passive transfer tests were performed with the Prausnitz-Küstner technique using serum from grass hay fever patients in 5 different dilutions. A total of 110 persons (54 men and 56 women), 18 to 96 years of age, were studied.

A positive Prausnitz-Küstner reaction could be elicited with the strongest antibody concentration in all cases.

With this antibody concentration old individuals (both women and men) gave significantly stronger skin reactions than younger persons. This phenomenon is possibly best explained by assuming that the blood supply to the skin is diminished in the aged. Weaker antibody concentrations did not show any difference in the size of the skin reaction in young and old individuals. In addition, it was demonstrated that women showed consistently larger wheals than men. This sex variation is probably due to an increased elasticity of the skin in women.

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THE USE OF HEPARIN WITH TESTOSTERONE IN PARKINSONISM

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THE present status of therapy in Parkinsonism is unsatisfactory, being largely limited to drugs having a palliative effect upon certain features of the condition. At times relief of spasticity has been achieved, again the mental depression so often found is helped. This may be accomplished only at the expense of visual disturbances, oral dryness, etc., resulting from the side effects of the anti-Parkinsonism therapy. To the present no specific or even satisfactory symptomatic treatment has been found for Parkinsonism. Indeed, the cause of Parkinsonism is not clear in any event and it is probably a symptom only. Cerebral arteriosclerosis is regarded by some as one of the causes.

Proceeding upon the hypothesis that in such cases the arteriosclerotic disturbance might be associated with a catabolic action in the lenticular-hypothalamic area and a further disorder of the extra-pyramidal-hypothalamic-endocrine system, a plan of therapy was chosen which we believed might favorably influence the vascular supply of this region. A total of 17 cases, all males, ages 55 to 73, were selected after screening several hundred records from the Domiciliary population. Following examination and questioning these were considered to have Parkinsonism of an arteriosclerotic or idiopathic type. On subsequent review, several of these patients were suspected of having encephalitis as an etiologic factor, although this cannot be determined definitely.

Procedure

Following examination and questioning, motion pictures of gait and penmanship were made, weights were recorded, and cards were issued for the subjective recording of the various symptoms considered to be the most significant in Parkinsonism. Inasmuch as the 17 patients were the sum total of the arteriosclerotic variety available in the Domiciliary population and since the well known variability of symptomatology in Parkinson cases precluded parallel series, all patients received identical treatment. The six months' period of observation was divided into three equal parts. During the first two months this consisted of intramuscular injection of 100 mg. Depot-Heparin three times weekly, combined with 100 mg. Depot-Testosterone once weekly. Treatment for the second two months consisted of placebo of sterile saline injections. During the third two month period injections of Depot-Testosterone 100 mg. per week were given.

The routine feeding, care, and prior medication was not altered for these patients during the course of treatment. Periodic clinical examinations were performed, motion pictures were repeated, and evaluations were made of the patient's subjective reports. The methods used for evaluation of the subjective reports included: nurse questioning of the patients, information given by other patients, and reports to physician as expressed by the patients verbally and by check cards. In addition, checks of the patient's weight, examination of the coagulation time and routine urinalyses were performed once weekly. Bi-weekly complete blood counts were made on the majority of patients. Occasional cholesterol levels were obtained, which ranged from 140 to 463 mg.%, with an average of 248 mg.% for all patients.

Results

Period of Heparin-Testosterone Treatment.—Objective improvement was observed principally with regard to body weight and salivation. Thus during the first eight weeks of treatment there occurred an average weight gain of 2.46 lbs.; some patients during this

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period gained as much as 8 lbs.

Concerning the effect on salivation during the period of heparin-testosterone therapy, 4 patients ceased drooling, these 4 patients having, despite all previous therapy, drooled for 32, 20, 10, and 5 years, respectively. The salivation in 4 other patients was markedly improved, whereas no change was noted in 2 other patients. The 7 remaining patients had exhibited no salivation at any time.

The inherent dangers of subjective data in patients with chronic diseases are recognized. Subjective improvement was noted in several categories, namely, improved well-being, increased strength and activity, and improvement in sleeping. Particularly was it noted that very few patients stated being worse than before treatment, although 2 patients discontinued therapy because of progressively increased nervous tension during the treatment.

Of unusual improvements noted, 1 patient after heparin-testosterone had no more of previously constant brief periods of immobility with staring and dysarthria. Another patient on heparin-testosterone lost his attacks of "twitching" of neck and left shoulder. In those categories of signs more commonly associated with Parkinsonism, namely tremor, restlessness, and rigidity, no consistency could be obtained in the results.

Complications were absent except for several minor hematomata at the sites of heparin injections.

Period of Placebo Administration.—During the two month period of placebo administration a general regression of the recorded improvement was noted. An average weight loss of 2.5 lbs. occurred. One patient, who had gained 6 lbs. in weight during the heparin-testosterone treatment and who had experienced increased mobility and improved speech and alertness, on placebo administration lost 5 lbs. and went into a state of mental confusion with paranoid episodes.

Three of the 4 patients who had ceased drooling during treatment with heparin and testosterone did not suffer any relapse of salivation, while a reoccurrence of drooling was observed in the fourth patient. One of the 4 patients, who had experienced a marked improvement but not a complete disappearance of the drooling during heparin-testosterone therapy, maintained the improvement during placebo administration, whereas regression occurred in the remaining 3 individuals.

Period of Testosterone Treatment.—During the two month period of treatment with testosterone alone there was an average weight gain of 1.66 lbs. and strength and well-being tended to improve. The patient who on placebo administration had suffered from a state of mental confusion gradually regained mental clarity during treatment with testosterone and gained 1 lb. in weight. The salivation in only 1 patient improved on treatment with testosterone alone. Acne occurred as a complication to the testosterone therapy in 1 patient.

Discussion

Theoretically, one might presume, after the hypothesis of Gofman (2), Graham and associates (3), that the heparin might, by facilitation of lipoid removal from the arteriosclerotic cerebral vascular wall, increase the blood supply to and oxygenation of damaged cells in the substantia nigra, corpus striatum, other basal ganglia, and hypothalamus. Assuming weight loss in Parkinsonism to have a possible basis in lack of adequate anabolic hormone effect after hypothalamic damage, the long-acting testosterone was administered in conjunction with the heparin and may have acted to cause the major portion of the weight gain through its well known action in effecting nitrogen retention. Explanation of the beneficial effect on drooling, or salivation, is not so apparent. Furstenberg and Crosby (1) believe that the sialorrhea of Parkinsonism is due probably to malfunctioning of the lenticular nuclei with either release or irritation phenomena transmitted by the ansa lenticularis and the lenticular fasciculus of Forel to the preoptic hypothalamus and so by way of the dorsal longitudinal fasciculus to the superior and inferior salivatory nuclei in the brain stem. Salivation is under dual physiologic control with excita-

tion of the function probably more frequently seen than the reverse (4).

The observations we have made lend themselves to much speculation, but, being of preliminary nature, require extension and confirmation before explanation is possible.

Summary

A series of 17 male patients with so-called arteriosclerotic Parkinsonism were observed over a period of six months while under therapeutic management with long-acting heparin and testosterone. These drugs were given at first in combination and later, after an interval, testosterone alone was given. The patients gained weight and strength and exhibited marked amelioration of sialorrhea. The Parkinsonian process was otherwise not consistently retarded.

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PRESBYTERIAN MINISTERS AND THEIR WIDOWS IN RETIREMENT

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PRESBYTERIAN ministers do not as a rule want to retire, they fail to plan for retirement, they enjoy fairly secure economic status, and are almost as happy when forced into retirement as they are in the active ministry.

Their widows viewed the retirement of their husbands with mixed emotions, noticed that 1 out of 4 husbands exhibited important personality changes after they retired, believed the Church had provided for their husbands as well as it could, doubted that their husbands would have lived longer had they received more money during retirement, and described themselves as reasonably happy.

These are some of the conclusions drawn by questionnaires sent in 1952 by the Board of Pensions of the Presbyterian Church in the U. S. A. to 1608 retired ministers on its pension rolls and to 1818 widows of former pensioners who continue to receive pensions and grants from the Church.

The following tabulations were made from replies received from 920 ministers and from 1290 widows. The tabulations were converted into percentages for convenience in comparison of replies. The questionnaires were not signed in order to reduce self-consciousness and eliminate any tendency to plead a cause, and the recipients were urged to express themselves with complete freedom.

Some of the questions asked the Presbyterian group were the same as those posed by Shanas and Havighurst (1) as reported in their study of 1100 retired Methodist ministers, and wherever possible their tabulations are compared with those received from the Presbyterians.

The Service Pension Plan of the Presbyterian Church in the U. S. A. is a contributory plan with survivor benefits. Each active minister pays 3 per cent while his church or employer pays 9 per cent of his annual salary as annual dues. His pension benefits accrue at the rate of 1¼ per cent of his salary each year so that if he contributes for forty years he can retire on a pension equal to half his average annual earnings during that period. In computing the salary base, 15 per cent of the cash salary is added for manse, if one is provided, making the salary base for computation of pension 115 per cent of cash salary.

The pension is paid only upon retirement. If the minister dies, the widow receives half the pension her husband had accrued or was receiving and minor children receive $100 annually during minority. The Plan provides an additional insurance feature which pays the widow half the husband's annual salary (maximum $2500) if he dies in the active ministry before 65 and up to $500 if he dies after 65. There are additional educational benefits for the minor children.

The Plan has been in effect since 1927 and will mature in 1967. Because the men now in retirement and the husbands of the widows now on pension never were able to accrue the full benefits of the Plan, the average pension paid in 1952 was $555 and the average widow's pension was $290.

The questionnaires, reported herein, were designed to discover the situation of the retired men and their widows in order to enable the Church to direct its attention and its funds to the areas of greatest need.

While excerpts from these questionnaires have been used in reports to the Church this is the first publication of the complete study and is released with the hope that it will be of scientific value in the important studies now being made in the field of gerontology.

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Ministers

Basic Information

All the ministers replying were 65 or older. Their desire to keep preaching is indicated by the fact that while retirement on pension is possible under the Service Pension Plan (and Old Age and Survivor Insurance) at 65, the average retirement age for these Presbyterians now stands at 68.3.

That ministers decide to retire with some reluctance is indicated by the answers to:

1. How did you approach retirement?

With happiness	20%
With mixed feelings	64
With indifference	3
With misgivings	13

Their failure in large numbers to plan carefully for retirement is shown by the answer to:

2. One year before retirement had you taken any of the following steps?

Checked to discover what pension would be	65%
Arranged for future living accommodations	56
Discussed retirement with children or close relatives	46
Discussed retirement with Session of Church	34
Discussed retirement with other ministers	21
Arranged for future employment	13

Personal health and concern for the welfare of the church were the major causes leading to their retirement, the ministers reported.

3. Why did you retire?

Declining strength	42%
Felt my work at this church was finished	26
Believed the church needed a change	17
Wife or family health problems	15
Difficulties in the local church	4
Social or family problems other than health	3
Other	26

Churches utilize the services of retired men in various capacities, ranging from full time pastoral service to occasional supply. The extent of this work is indicated by:

4. After you retired, did you return to the active service of any local church for several months on a salaried basis? Yes 40%; No 60%. If so, in which of the following capacities:

Occasional supply	99%
Stated supply (Interim-full time)	60
Summer vacation supply	33
Full time service	25
Parish visitor	16
Other	29

That the retired men are a real cross-section of those serving the Church appears from their statements regarding their past service. The percentages are interesting in comparison with the percentages of the number of churches in the various membership ranges, showing that, for example, only a quarter of the men served small churches, which comprise 60 per cent of the total, all their lives, and 12 per cent preached before the largest churches, although they number only 5 per cent of the total.

5. What was the largest congregation you served?

Church Membership	% of Ministers	% of Churches in Denomination (1950)
Up to 200	27	60
200 to 500	42	24
500 to 1000	19	11
More than 1000	12	5

The middle years are judged by the ministers to be their most effective period of life although a sizable proportion believed they had maintained a fairly constant level throughout their ministry.

6. In your opinion, during what ten year period did you do your best work?

25-35	2%	45-55	14%
30-40	4	50-60	14
35-45	7	55-65	11
40-50	13	60-70	9

Generally maintained same level 26%

Once retired, more than half of the ministers have not changed residence, with another large group moving once.

7. How many times have you changed permanent residence since retirement?

None	56%	Four times	2%
Once	22	Five times	1
Twice	10	More than five	2
Three times	7		

A desire to live near relatives was given by the largest number of those who moved for their change in residence.

Live near relatives	26%	Wanted to live in:	
Better climate	21	Country	8%
Less expensive place	20	Suburbs	6
Health	19	City	3
Live with relatives	14	Miscellaneous	33
Return to home town	13		

Ministers face upon retirement a problem that rarely bothers other men—their continued residence in the community they served may

become a source of difficulty for their successors. It is frequently hard for the new minister to carry out a program while his predecessor lives in the community and attends the church he formerly served. Loyalties of the congregation to the retired minister often conflict with creation of loyalties to the new minister. The majority of the retired men believe it is wiser to move, thus cutting themselves off from the people they know and love the best.

8. Do you believe it advisable to retire in the community where last you served? Yes 22%; No 78%.

Ninety-one per cent of the ministers had wives when they retired and reported their wives' attitude on retirement as follows:

9. How did you wife feel about retirement?

Favored it	64%
Had mixed feelings	28
Disapproved	1
Regretted it	7

Questions 10 and 11 showed that 93 per cent of the men planned retirement in consultation with their wives and the 90 per cent who had living children reported that 44 per cent of the children favored retirement, 37 per cent believed the decision lay with their father, 12 per cent made no comment, 6 per cent regretted it, and only 1 per cent disapproved.

Inadequate preparation for retirement was revealed by the following:

12. Did you discuss your plans for retirement with any of the following:

Friends	25%
Physician	24
Member of Session (Church officer)	24
Board of Pensions representative	23
Presbytery Pensions Chairman	12
Any agency of the Church	8
Banker	3
Insurance man	3

Two-thirds of the ministers either considered themselves unable or were not interested in continued full time work at a lower stipend.

13. At the time you decided to retire, would you have been interested in moving to a different community as an associate or assistant pastor at a reduced salary? Yes 33%; No 67%.

A few of those who answered in the negative to the above would have been willing to accept the less arduous duties of a parish visitor as shown by:

14. Would you have been interested in becoming a parish visitor at a reduced salary? Yes 36% No. 64%.

If yes, would you have moved 500 miles to a new community to do this work? Yes 49%; No 51%.

This part of the questionnaire seems to indicate clearly that Presbyterian ministers want to go on preaching and serving their people as long as their health will permit and retire only through weariness or through conviction that their usefulness to their churches has ended. They fail to prepare adequately for retirement. Only about a third believed they could have continued to carry on full time work.

From the point of view of the Church it would seem that the services of its older men are being utilized about as well as their strength will permit. The answers to the next section seem to confirm this judgment.

Present Interests and Attitudes

Nearly half of the retired men are earning money, either as self-employed persons or in the employment of others. The Presbyterian percentages are shown in comparison with the Methodist answers to a similar question.

15. Are you earning any money at present, and if so, how many hours per week does this take?

	Presbyterians	Methodists (1)
Not employed	53%	41%
Employed	47	58
Full time (40 hrs.)	10	16
Part time (5 to 40 hrs.)	29	18
Occasional (less than 5 hrs.)	8	22
Unknown		2
No data		1

The question regarding residence was surprisingly favorable with its report of extensive home ownership among the retired ministers. The average (1950) for the United States for persons over 65 was 68.2 per cent (2). As shown below, the ministers approach that figure.

16. Where are you now living?

Own home	59%
Rented house or apartment	16
With relatives or children in their home	9
In a home for the aged	5
In home or apartment, rent free	4

Rented room	2
Nursing home	0.5
Elsewhere	4.5

The vast majority of the retired couples prepare the main meal themselves.

17. Do you (and your wife) generally prepare and cook your own food for the main meal of the day? Yes 87%; No 13%.

Activities of the retired men, in which they reported spending "some" or "a lot of time" cover a wide range. Here again comparison with the Shanas-Havighurst report is possible although the Presbyterian questionnaire listed a great many more activities than the former.

18. In which of the following activities do you spend "some" or "a lot" of time?

	Presbyterians	Methodists (1)
Gardening	49%	64%
Reading	78	90
Traveling	44	51
Participation in civic affairs	18	39
Participation in church work (unpaid)	38	82
Painting, writing	29	27
Participation in older people's groups	not asked	40
Clubs and organizations	not asked	17
Radio listening	50	77
Crafts	30	not asked
Housework	37	not asked
Cooking	22	not asked
Visiting others	43	not asked
Marketing	35	not asked

One quarter to a third of the men would be interested in work if it were available, and a sixth actually tried to find employment.

19. If you are not now working,

(a) Would you be willing to accept a position for which you are suited by experience and health if it involved six hours work a day away from home for five days a week? Yes 27%; No 73%.

(b) Would you be interested in any secular paid employment? Yes 33%; No 67%.

(c) Have you actually tried to find employment during the past twelve months? Yes 16%; No 84%.

Occasional or fairly regular preaching provides the majority activity and source of income during retirement, but the extent of such employment is not as great as many would estimate.

20. How many times did you preach during the past twelve months?

None	31%	10 to 20	20%
1 to 5	22	30 to 60	13
5 to 10	13	Over 60	1

If you have preached did you find your preaching:

Stimulating	84%
Difficult but rewarding	15
A burden	1

Replies to specific questioning about earnings and sources of income were again pleasantly surprising in that they revealed the ministers to be in better financial condition than had been expected. Seventy-eight per cent were receiving half or more of what they were earning prior to retirement. Many saved and invested against the time of retirement.

21. How does your dollar income from all sources compare with the salary you were receiving at the time you retired?

As much or more	23%	A fourth	10%
Three-quarters	21	Less than a fourth	12
Half	34		

22. What portion of your present total income is received from church pension plans?

Less than a fourth	25%	Over three-fourths	6%
A fourth to a half	34	Pensions only income	19
A half to three-fourths	16		

23. What are your sources of income?

Church Pension Plans	100%
Dividends or interest	55
Rentals	23
Gifts	22
Help from children	17
Social Security	9
Pastor emeritus grant	7
Old Age Assistance	4

Presbyterian ministers reported that they considered themselves economically secure in exactly the same proportion as their Methodist confreres.

24. Do you feel economically secure?

	Presbyterians	Methodists (1)
Yes	62%	62%
No	38	24
Questionable		9
No opinion		5

The Presbyterian men, more than 70 per cent, believe they are as well off as others of their same age in the community. The exact ratios were as follows:

25. Compared to other persons of your age in your

community do you believe your own economic situation is:

Better than average	18%
Average	55
Below average	29

The feeling of economic security may or may not be related to the feeling of happiness in retirement as reported in answer to the next question.

26. Compared to when you were preaching full-time are you generally:

Happier	9%
As happy	63
Not as happy	28

The ministry with its emphasis on service to others has both rewards and penalties in retirement as indicated by the answers to the next two questions. The satisfactions that come to one who hears "Well done, Thou good and faithful servant" are offset by the decline in physical strength and the sense of being forgotten or of being no longer needed.

27. Which of the following do you like best about retirement?

Remembrance of work well done	49%
Freedom from responsibility	46
Freedom from routine	39
New opportunities for service	36
Opportunities for hobbies	22
Don't have to work so hard	18

28. Which of the following are of real concern?

Loss of income	33%
Decreased strength	33
Health problems	28
Loss of sense of being needed	21
Loss of hearing	20
Feel forgotten and neglected	10

Despite problems of finance, health, and loneliness, the ministers in overwhelming proportion continue to believe their lives have meaning and purpose.

29. (a) In your own opinion are you continuing to lead a useful life? Yes 94%; No 6%.

(b) If the answer is yes check one or more of the following which seem important to you.

Service to others	81%
Prayer for others	80
Preaching	59
Counselling	50
Keeping others happy	43
Sunday School teaching	33
Parish work	18

As ministers are usually regular readers, their tastes in literature in retirement give some clues to their interests in retirement.

30. Other than the Bible and religious writings, what kind of reading interests you most? (One or more may be checked):

Newspapers	79%
Magazine articles	67
Biography	58
Travel	34
Fiction	28
Poetry	26
Mystery stories	14
Foreign languages	9

The serious plight of a small percentage of the retired men is indicated by the answers to the next 2 questions.

31. What proportion of your income was needed for medical expenses in the last twelve months?

Negligible	33%
Less than 10%	35
10 to 25%	23
25 to 50%	4
More than 50%	5

32. Are you actually in need for the necessities of life? Yes 7%; No 93%.

Opinions About Retirement

Believing that the retired ministers on the basis of their actual experience could provide sound counsel for the Church, and especially for those yet to retire, the Board questionnaire asked questions relating to the Church, ministers, and government programs.

The first 2 questions indicated that ministers think of their work as in a different category than that of employees of church boards and agencies.

33. Should retirement for ministers be compulsory at a specified age? Yes 29%; No 71%.

34. The General Assembly has made it mandatory for employes of the Church boards and other agencies to retire at 70. (This does not apply to service to a local congregation.) Do you believe this is a wise provision? Yes 49%; No 32%; No opinion 19%.

Questions relating to the programs of the Church and governmental retirement and assistance plans were as follows:

35. Do you believe a pension plan should be flexible, permitting retirement at varying ages? Yes 70%; No 12%; No opinion 18%.

36. Should the Church attempt to formulate a plan whereby a minister as he grows older might reduce the burden of his work by becoming an associate with or assistant to a younger man, thereby continuing the older man in active service at a reduced salary? Yes 79%; No 21%.

At the time the questionnaire was sent out the Church had no official attitude on ministerial participation in the Social Security program. Since that time the General Assembly has approved such participation on a voluntary basis.

37. Do you think our Church should seek to have the law changed so that ministers would automatically participate in the Social Security program? Yes 43%; No 28%; No opinion 29%. (It should be noted that the question asked about automatic participation. Probably more ministers would have answered in the affirmative had the question asked about voluntary participation.)

38. (a) Do you believe retired ministers should accept Old Age Assistance if they are eligible? Yes 90%; No 10%.

(b) Do you believe ministers' widows should accept OAA if eligible? Yes 95%; No 5%.

39. Should children be expected to contribute to their parents' support if it is needed? Yes 81%; No 19%.

40. What is the minimum yearly amount on which a single person of your age and in reasonably good health should be asked to live (in 1952)? (Answers were averaged): Men $1514; Women $1393.

41. On the basis of present living costs, how much more money each year would you need to be reasonably comfortable? (Answers were averaged): $778.

42. What is the minimum yearly amount on which a couple about your age and in reasonably good health should be asked to live? (Answers were averaged): $2168.

43. Do you think you would live longer if you had more money? Yes 29%; No 71%.

44. What would you do with a single gift of $500 if you were to receive it today?

Save it	46%
Use it for medicines	12
Buy clothes	12
Give it to a person in need	12
Pay outstanding bills	9
Buy better food	8
Buy hearing aid	8
Have an operation	4
Change to better residence	3
Buy a radio or TV	2
Miscellaneous	23

45. If you were advising a minister in the age group 55 to 65 concerning retirement which of the following would you urge him to do on the basis of your own experience?

Discuss the future with his wife and children	72%
Determine as accurately as he can what his future income will be	72
Plan for future living accommodations	65
Plan for the utilization of time after retirement	64
Consult with a representative of the Board of Pensions	56
Ascertain living costs in different areas of the country	39
Consult his physician	37
Develop some hobbies	37
Explore community activities for old people	25
Move to a better climate	22
Other	20

The last 3 questions throw light on what ministers think the Church should provide in the way of living accommodations and the type of accommodations they would most desire.

46. Would you approve of the establishment of additional residential homes for retired ministers, their wives, and widows by the Church? Yes 84%; No 16%.

47. Would you have been interested in living in a church-sponsored low-cost housing community at low rent if all the other residents were retired ministers and their wives or widows? Yes 45%; No 55%.

48. Rather than have your own home, would you prefer to live in a larger home with a room of your own and freedom to come and go as you wish, but be required to eat all your meals with the other guests? Yes 17%; No 83%.

Widows

The widows' questionnaires were designed to elicit two types of information: experiences while living with their husbands in retirement and their own experiences following the death of their husbands. At the time of retirement ministers' wives average about six years younger than their husbands.

In a special way the minister and his wife in the Protestant ministry comprise a team. The wife serves not only as wife and mother and mistress of the home, she also serves the local church in a vast variety of ways. It is quite proper, therefore, to consider both husband and wife as retired from the service of the Church and to consider the widow in a

special sense as a retired servant of the Church.

Many of the questions addressed to the widows parallel those sent to the ministers. Wherever possible the comparisons, especially in attitudes which these women believed their husbands held and which they held about their husbands and their life in retirement together, will be indicated.

Basic Information

1. Age:

Under 50	3%	65-75	38%
50-65	24	Over 75	35

2. How many years have you been a widow?

Less than two years	14%	10-15 years	20%
2-5 years	24	15-20 years	12
5-10 years	26	Over 20 years	4

3. Do you have living children? Yes 88%; No 12%.

Life with Husband in Retirement

These questions were, of course, not answered by women whose husbands had died in the active ministry.

In assigning their reasons for retirement, the two major reasons given by the ministers were "declining strength, 42 per cent" and "felt work was finished, 26 per cent." Convictions regarding the need for a new pastor or difficulties in the local situation accounted for another 21 per cent. The widows answered the same question as follows:

4. In your opinion, what led to your husband's retirement?

Concern for his health	44%
Your belief he should retire	10
Belief that his work was ended	7
His desire to be free from the burdens of the pastorate	7
Your children's belief that he should retire	7
Suggestions by Session or Presbytery	5
Miscellaneous	15

5. Did he consult you before making his decisions? Yes 94%; No 6%.

This compares very closely with the 93 per cent of the ministers who said they had consulted their wives about retirement.

6. Did you think he ought to retire at the time he did? Yes 94%; No 6%.

The ministers said, however, that only 64 per cent of the wives approved, many others viewing the retirement with mixed feelings.

7. At the time of retirement did you think he was still capable of continued service to a local church? Yes 36%, No 64%.

This again compares very closely with the belief of the men as evidenced by their answers to Question 13 above.

As the widows think back, more of them would have been willing for their husbands to continue full time work than were the ministers. Only 33 to 36 per cent of the ministers would have been willing to continue in a less responsible full time position. Less than half of the widows said they would have objected.

8. At the time of retirement would you have objected to your husband becoming an assistant minister or parish visitor in a different church? Yes 44%; No 56%.

9. With what feelings did you approach the time of his retirement?

Happiness	6%	Misgivings	14%
Acquiescence	20	Mingled feelings of happiness and regret	60

Difficulties of retirement for the minister as seen through the eyes of his wife were revealed in the widows' answers to the next group of questions.

10. (a) Did you urge him to seek employment after retirement? Yes 8%; No 92%.

(b) If he found other employment was he happier while working? Yes 86%; No 14%.

11. Did he exhibit any important changes in personality during retirement? Yes 25%; No 75%.

12. Comparing his happiness in retirement with his happiness a year before retirement was he:

Happier	11%
Less happy	41
Unchanged	48

Significant difference is shown here in the widows' evaluation as compared with the ministers'. The latter said they were "happier 9 per cent," "not as happy 28 per cent," and "unchanged 63 per cent."

13. Where were you living as a couple six months following his retirement?

Own home	62%	With one of our children in his home	4%
Apartment or room	17	With other relatives in their home	4
Home for aged	2	Miscellaneous	11

14. On retirement did your husband find it difficult to adjust to the relative freedom from his former routine? Yes 43 %; No 57%.

15. After your husband retired did he seem to you to be constantly "under-foot"? Yes 5%; No 95%.

The fact that during his active ministry a clergyman spends more of his time in his home than does the average business or professional man would doubtless account for his continuous presence about the home proving no source of difficulty.

16. Did your husband seem at a loss to know what to do with his time? Yes 21%; No 79%.

17. As far as you could tell, did he believe that, on the whole, the Church had treated him

Better than he expected	12%
As well as it could	72
Not very well	16

18. What was the greatest single material problem you had to meet during his retirement?

His declining heatlth	54%
Lack of funds	34
My health	4
Adequate living accommodations	4
Miscellaneous	2

The fact that the widows are reporting for a group with, on the average, much smaller pensions than the ministers is apparently responsible for the answers below relating to income which show a less favorable situation than that reported by the ministers.

19. (a) After retirement did the two of you have enough income on which to live in reasonable comfort? Yes 50%; No 50%.

(b) Did you have to use some savings or capital to meet expenses? Yes 80%; No 20%.

These answers indicate that at least half felt economically insecure during this period, while 62 per cent of the ministers now living in retirement feel secure.

20. Did you think his pension was adequate? Yes 13%; No 87%.

The widows, however, apparently recognize in virtually the same proportion as the minister group that increased income bears little relation to longevity.

21. Would he have lived longer if there had been more money? Yes 24%; No 76%. (Asked this question about themselves, the ministers answered, Yes 29% and No 71%.)

22. Did your children help you financially after his retirement? Yes 44%; No 56%.

23. (a) Did you do any paid work while your husband was retired? Yes 25%; No 75%.

(b) If so, did your husband object to your working? Yes 26%; No 74%.

24. To your knoweldge did your husband ever apply for Old Age Assistance? Yes 6%; No 94%.

25. Was your husband opposed to ministers receiving OAA grants? Yes 5%; No 30%; Don't know 65%.

26. Do you believe it wise to retire in the community where you husband last served? Yes 31%; No 69%. (The ministers answered this question, Yes 22%; No 78%.

Widows' Present Situation

Under the Church's Pension Plan, when the minister dies the widow receives half the pension or grant which her husband had been receiving. As many as these widows' husbands had retired before the Plan became effective, or in the early stages of its development, their husbands' pensions were very small and their survivor benefits in many cases are negligible. Consequently, more financial insecurity is reflected in their answers to the questions about their present situation.

An even greater failure of the Church is shown in other answers indicating loneliness, a feeling of being forgotten, a loss of the sense of being wanted.

27. Where are you now living?

House	63%	City of over 50,000	32%
Apartment	24	City of 10,000-50,000	21
Furnished room	5	Town of 1,000-10.000	25
Home for the aged	4	Town of less than 1,000	9
Hospital	1	Farm	3
Other	3	Suburban area of large city	10

28. With whom are you living?

Alone	44%
With children	33
Other relatives	13
With friends	6
Other residents of home for aged	4

29. Ordinarily, do you prepare and cook your own meals and, ordinarily, how many times do you eat each day?

Yes	76%	Four times	1%
No	24	Three times	91
		Two times	8

30. Indicate all the sources of your income?

Church Pensions	95%	Rentals	15%
Dividends and interest	46	Social security	4
		Old Age Assistance	3
Insurance or annuity	22	Church grant	2

Salary	20	Trust fund	2
		Gifts from churches	1

31. Do you feel that you have economic security? Yes 47%; No 53%.

Smaller pensions income may account for the sharp difference shown here between the widows and the ministers, the latter reporting that 62 per cent considered themselves secure.

32. What are your own most difficult problems at present?

Money	44%	Finding useful activity	7%
Health	41	Worry about children	6
Living accommodations	10	Filling my days	5

During the time the husbands of these women were living, the greatest problem was the husband's health, with inadequate funds second. With his death and the halving of pension income, money becomes of primary concern with their own health second. Their need for funds is underlined in their answers to the next questions.

33. Would more money solve all your problems? Yes 51%; No 49%.

34. If you were to receive a single gift of $500 what would you do with it?

Save it	37%	Move to a better residence	5%
Use it for medical care	33	Buy a hearing aid	4
Give it to others	10	Have an operation	3
Buy better food	9	Buy a radio or TV	1
Pay old bills	7	Other	16
Buy clothes	6		

The widows try to fill their days with various activities.

35. In which of the following activities are you taking any part?

Church	80%	Hospital work	7%
Church School	31	Discussion group	6
Women's Club	20	Older persons' club	5
Community Service agency	9	Other	7

36. In which of the following recreational or non-salaried activities listed below do you spend "some" or "a lot of time"? (Only those activities with more than 50 per cent responses are included below.)

Reading	81%	Sewing or knitting	61%
Housework	76	Visiting others	58
Writing letters	72	Church work	57
Cooking	69	Gardening	54
Listening to radio	62		

37. (a) Are you now gainfully employed? Yes 26%, No 74%.

(b) If you are not, would you accept such employment if it meant working away from home five days a week, six hours per day? Yes 17%; No 83%.

38. Do you feel your children or other close relatives understand your problems? Yes 63%; No 3%; To some extent 34%.

39. How would you describe the attitudes of your children or other close relatives?

Helpful in every way	56%
Want to be helpful but have too many problems of their own	28
Interested but too far away to help much	25
Loving but too protective	3
They seldom write	3
They think I don't need their interest and affection	1
Neglectful	1
Other	1

40. How would you describe your present life?

Comfortable	70%	In between	24%	Difficult	6%
Secure	29	Moderately secure	57	Insecure	14
Satisfactory	58	Mixed	36	Empty	6
Useful	75	Not very useful	23	Mostly wasted	2
Happy	43	Reasonably happy	54	Unhappy	3

41. How much more money, if any, would you need for yourself each year to be reasonably comfortable? (Answers were averaged) $814. (This is more than the average of the answers received from the ministers to the same question—$778.)

Widows' Opinions on Problems of Later Maturity

Hostility to the receipt of Old Age Assistance, which many regard as public charity, and to participation in Social Security because of both religious concepts and political beliefs are reflected below.

42. Would you be opposed to receiving Old Age Assistance? Yes 28%; No 72%.

43. Do you believe ministers in the active pastorate should be permitted to enter Social Security? Yes 48%; No 11%; No opinion 41%.

Their comments on attitudes of the Church as compared with those of the general public are interesting.

44. Do you believe the Presbyterian Church is actively trying to solve the problems of its older ministers, their wives, and widows? Yes 82%; No 18%.

45. Do you think the people of the United States generally understand the problems of older people? Yes 25%; No 75%.

Returning to the Church and its programs the widows expressed themselves as follows:

46. (a) Do you believe the Church should provide more residential homes for its retired ministers and their wives? Yes 91%; No 9%.

The widows are more emphatic on this point than the ministers, only 84 per cent of them favoring the erection of such homes.

(b) If you favor such homes, which of the following would you prefer?

Low cost housing where the couple or individual keeps house and remains independent	47%
Homes or apartments where light housekeeping is possible but meals are provided if desired	46
Homes where meals are provided	7

47. Do you believe that ministers should definitely be retired at a specified age? Yes 32%; No 68%.

There is not any important difference in the widows' answers as compared with the 29 per cent of the ministers who answered this question affirmatively.

48. Do you believe the Pension Plan of the Church should be improved? Yes 94%; No 6%.

49. (a) Do you believe the children of ministers should be asked to help their parents if the need arises? Yes 77%; No 23%. (The ministers answered this question with 81 per cent affirmatives.)

(b) Do you believe such aid from the children should be requested only if the Church fails to provide a sufficient amount? Yes 78%; No 21%.

50. Based on your own experience, which of the following suggestions would you make to a young minister's wife?

Encourage her to save	59%
Discuss future retirement plans with husband	51
Study the Pension Plan	51
Insist on regular physical examinations for both	48
Start early to build a home for retirement	42
Urge her husband to plan for his retirement in consultation with insurance expert	41
Develop or maintain her capacity for paid employment	40
Buy more insurance	24

A final series of questions relating to ideal conditions reveals the kind of life the widows consider satisfying and comfortable.

51. In general, do you think it wise for a widow to live in the household of her married children? Yes 3%; No 97%.

52. If you had your choice, where would you like to live?

House	52%	Woman's Club	3%
Apartment	34	Hotel	2
Home for aged	10	Other	1

53. If you have your choice, with whom would you like to live

Alone	43%	Residents of home for aged	10%
Another congenial widow	20	Friends	8
Children	19	Other relatives	5

54. In what location would you prefer to live?

Small rural community	14%	Suburb of large city	23%
Small city	41	No answer	13
Large city	9		

55. How far away from your children would you be willing to live?

Few blocks	43%	Up to 500 miles	13%
10 miles	18	Up to 1000 miles	6
100 miles	15	Up to 3000 miles	5

56. In your opinion what is the minimum amount on which a widow, of about your own age in normally good health and without dependents, should be asked to live? (Answers were averaged) $1508.

The widows believe they need more than the ministers think a single woman would require, their answers to this question averaging $1393.

Summary

Pre-retirement and post-retirement attitudes and experiences of 920 retired Presbyterian ministers and 1290 widows of Presbyterian ministers have been studied through independent questionnaires sent to each group. The majority of both ministers and widows seem to have adjusted adequately to the problem of retirement, report themselves as fairly secure economically, and express their belief in the importance of planning for retirement.

Sizable proportions, however, of both the men and women are apparently in genuine need not only of money, but also of adequate living accommodations, useful activity and of being wanted. In meeting these needs the Presbyterian Church is now taking constructive steps.

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ANALYSIS OF OLD AGE POLITICS IN THE UNITED STATES

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POLITICAL behavior on the part of our aged citizens, as such, and the nature of its impact upon our social security system have remained neglected subjects in the field of gerontology. The most recent studies which refer to old age politics, those of Fisher (9) and Pollack (19), point to a startling paucity of knowledge, although old age movements exploded upon the American scene as early as 1933 and can be expected to agitate politics for years to come. At the same time the increasing proportion of aged people among eligible voters has caused serious alarm in many quarters. It is the purpose of this article to explore two major questions in the hope of contributing to a better understanding of the problem of old age politics: 1) Why have the aged in the United States undertaken independent political action in contrast to a conspicuous absence of such behavior elsewhere? 2) To what extent will old age pension movements play a role in the social security politics of tomorrow?

THE ROLE OF OLDER CITIZENS IN SOCIAL SECURITY POLITICS

Faced with grave problems of old age insecurity, governments everywhere have been called upon to assume an increasingly greater role in providing for the older citizen. Only in the United States, however, have older citizens acted as a separate political force, banding together to impose their special demands upon society. The significance of this behavioral pattern has been largely overlooked. With the exception of an abortive attempt to organize a Townsend Movement in Canada, political movements among the aged failed to emerge in other countries. In the United States, the very nature of the Social Security Act has from its inception been intimately affected by the politics of the aged. Elsewhere the enactment of social legislation for the aged has been disassociated from any special efforts by old people as a group.

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THE ABSENCE OF A SEPARATE POLITICAL ROLE OUTSIDE THE UNITED STATES

A combination of factors foreclosed the possibility for separate political consciousness and action on the part of old people in countries of European culture. Protection for the old was provided in varying degrees by most of the major countries of the world long before our Congress was compelled to deal with this problem in the depression decade of the 1930's. Toward the end of the 19th century other governments had already begun to deal with old age insecurity on a systematic national scale. What characterized other countries so as to explain the absence of old age pension movements? It might be surmised that an earlier concern with the problem of old age insecurity antedated the full development of popular democratic government. The reverse is true, however, for national protection of the aged coincided with and benefited from the expansion of democratization.

The existence of old age security systems may have helped prevent the formulation of specific demands on the part of the old people. Therein, however, lay no explanation why the aged failed to participate in the very inception and extension of these programs. *Independent old age politics failed to develop because citizens reaching advanced years were accommodated within major institutions, precluding any autonomous role for the aged in politics.*

The emergence of powerful labor movements and the leadership furnished by inflential Socialist parties preempted the role which old age pension movements fulfilled in the United States. It is evident that the labor movements in the late 19th and early 20th centuries and

the Socialists were largely responsible for modern national plans protecting the aged.

In Germany a system of national compulsory old age insurance, the first of its kind, was initiated as one of Chancellor Bismarck's measures to defeat a rising Socialist movement. In some countries Socialists and labor enacted the initial legislation themselves. Hohman (13) credits the Social Democrats as being largely responsible for shaping social policy in Sweden, including old age protection.

In another set of circumstances, the nascent power of organized labor and the Socialists in alliance with political liberalism secured pension legislation. The Old Age Pension Law enacted in Great Britain, in 1908, its first great reform since the Poor Laws of 1601, arose primarily from the massive defeat suffered by the Conservative Party in 1906 at the hands of a coalition of labor and the middle class. True, the previous propaganda efforts of Canon William Blackley, the careful reports of Charles Booth, and Joseph Chamberlain's espousal of pension legislation contributed to a growing political concern with the problem. But it was the support provided by the Cooperative Unions, the Trade Union Congress, and the Fabians which furnished the political stimulus that made old age pensions necessary legislation for such radical Liberals as Lloyd George.

Across the world in New Zealand the Old Age Pension Law of 1896 was enacted under the auspices of a radical Liberal Party blending together a politically conscious trade union movement with land-hungry farmer groups. Lipson (16) points to the Old Age Pension Law as a successful political maneuver to regain for the Liberals the votes lost in the urban districts in previous elections. To cite one example in South America, the general compulsory old age and sickness insurance act passed in Argentina in 1923 is attributed by Epstein (7) to agitation on the part of organized workers.

To credit the role of labor and Socialism in the development of old age pension and insurance programs is to espouse the obvious. What must be emphasized is that these forces eliminated any grounds for a self-conscious political effort on the part of the aged. Aggressive, social security minded, and politically potent organizations advanced the interests of old people as an integral part of a general program of reform. Ideologically, moreover, the programs of Socialism and of labor left no place for the concept of an independent aged pressing separate demands upon society. In addition the serious divisions, social, economic, political, and even religious at times, into which the populations of most countries are so antagonistically split, precluded any new division on the basis of age alone.

The existing political environment was not conducive to separate pension action. An acceptance of a positive role for the state in many of these countries facilitated a national approach to old age protection. Secondly the major political parties, not only the labor-socialist left, undertook to promote old age pensions. In one of the few countries where pension legislation was not directly related to fear of Socialism or to labor agitation, Denmark, it was the progressive Left Party of the farmers which passed the first national non-contributory pension law (21). It is noteworthy that conservative as well as liberal parties have advanced the cause of social reform. Aside from an espousal by the parties, the parliamentary system helped prevent the emergence of independent pension groups. The non-party pressure group is at a disadvantage in attempting to maneuver between voter and candidate, between party leadership and legislator, and between executive and legislature in a parliamentary system.

The nature of the family and the general status of old people in European cultures further inhibited independent old age politics. Greater respect and social status are granted the aged in European cultures than in our own (10, 20). Sociologists have stressed the exceptional emphasis upon youth in contemporary American culture and the isolated position of the aged from "participation in the most important social structures and interests" (17).

The extreme conjugal type of family and the isolated role it forces upon old people failed to develop as extensively in Europe as in the United States. The European aged retained vital social and psychologic ties with basic institutions from which they derived status and respect.

Factors Leading to Old Age Politics in the United States

The forces creating old age insecurity in the United States were similar in many respects to those characterizing other countries. Industrial progress precipitated a devaluation in the status and situation of older people. In contrast to conditions of 1880 when the vast majority of our population was a rural one centering primarily around agriculture, by 1920 the majority was engaged in industrial and non-agricultural occupations, and over 50 per cent of the population resided in urban centers. The aged, too, were encompassed in this trend; by 1930, over 50 per cent of those 65 years of age and over were living in urban communities.

Under the impact of these altered conditions the former security of old people was shattered and any possible future security seriously impaired. The rural family in contrast to the urban one, as Smith (20) has shown, is a more cohesive unit with firm ties and one wherein aged parents and grandparents can contribute to its solvency. In the transition from a land economy to a money industrial economy the work of the older people lost its former value. The average city family no longer lived in dwellings adequate for the sheltering of aging parents and relatives. Nor were there large families, gardens, or kitchens in which the aged could be of assistance. The smaller size of the family contributed to the precariousness of old age. There were fewer children to provide for their parents, and the burden upon the younger people was consequently a greater one. Home ties and family solidarity were also weakened by the high mobility which has characterized the population in the United States. Under the impact of industrialization and urbanization, the sustaining and comforting support for the aged found in the rural community and the strong family disappeared for many.

At the same time the ability of the average worker to provide for old age and that of the older worker to retain his self-sufficiency were severely restricted. Changes in technology and a lowering of the hiring age weakened the position of old people within the labor force. A long term decline in farm employment and the expansion of occupations wherein older people were less relied upon greatly limited employment opportunities. In 1890 about two-thirds of all men 65 years of age and over were in the labor force; by 1930 this rate had declined to slightly over one-half (1).

As the American economy began to affect adversely the position of the aged, the proportion of older people within the population was increasing. Those 65 and over had constituted approximately 3 per cent of the total population in 1870, numbering 1,153,649; in 1930 this group comprised 5.4 per cent, or 6,633,805. The total population by 1930 had increased three-fold since 1870, but the number of those 65 and over was nearly six times as great as before. On the average men and women reaching 65 in 1930 could anticipate more than eleven additional years of life.

Another factor, the maldistribution of income, played a role in equating old age with insecurity. According to a study of family income and savings by the Brookings Institution (15) for the year 1929, three-fifths of the families in the United States earned $2000 or less and could save little or nothing. Not only were families of industrial and agricultural workers unable to save, but many in the so-called middle class found themselves in a similar predicament. As late as 1940 the Director of the Bureau of Employment Security, Social Security Board (2), characterized as fairly liberal estimates of 10 or 20 per cent for the number of persons reaching an independent old age through savings.

In spite of many similarities, socio-political conditions in the United States were radically different from those of other countries dealing with the problem of old age insecurity. As has

been pointed out with reference to the aged in European cultures, the emphasis upon youth in our culture and the predominance of the extreme type of conjugal family robbed many older people of a vital stabilizing force. Parsons (17) has suggested that this structural isolation from "kinship, occupational, and community ties is the fundamental basis of . . . political agitation" on the part of aged in America. The aged also remained isolated from any meaningful representation in the political or economical arena. With little if any political response emerging to minister to their needs during the depression, the aged became susceptible to appeals by new messiahs. Given a political environment in which pressure politics is an intrinsic part, they resorted to independent political action.

The movement for old age security up to the time of the depression was almost completely divorced from economic or political expression; conversely the efforts that were made stemmed from forces which were politically impotent. The relationship of economic and social problems to political results is generally only a function of the legislators' cognizance of what is considered potent in politics: organization, pressure, votes, and money.

Only in the 1920's did organized groups begin a concerted drive to secure pension legislation. It is a revealing commentary on the nature of this endeavor that the Fraternal Order of Eagles is given primary credit for the few state pension laws that were in existence. For years the leaders of the American trade union movement opposed any form of social insurance legislation, and it was not until 1922 that a national convention of the American Federation of Labor endorsed the principle of a federal old age pension. The A. F. of L. was primarily concerned with wages, hours, and working conditions. It did not compare in size, influence, or political maturity with the extensive labor movement in Europe nor did it incorporate their basic political approach or possess a similar link with Socialism. The American Association for Labor Legislation has become active in this field only since 1922. It was as late as 1927 that the American Association for Old Age Security, under the leadership of Abraham Epstein, was organized to unite community leaders and social workers in a campaign for the protection of the aged.

An abrupt deterioration in the condition of the aged brought about by the depression of the 1930's and the inadequacies of ameliorative measures helped create the potential from which old age pension movements arose. Evidence points to a continued isolation of the aged at the very time when their crisis had reached its zenith. In 1928 Epstein (7) estimated that 30 per cent of the aged 65 years and over were dependent upon others for support, the majority being assisted by relatives and children. In view of known statistics on the low incomes and the inability of three-fifths of the nation's families to save, the strain on family resources must have been great.

Only 6 of the 48 states provided old age assistance, less than 1000 persons being cared for. A few private pension plans and governmental retirement plans were in operation, but the number of persons covered was extremely limited, and many of the plans were poorly constructed and badly financed. The remainder of the dependent aged was compelled to seek the meager aid offered by private charity or that furnished by local communities through outdoor relief or almshouse confinement.

Estimates for 1930 placed the dependent aged at 40 per cent of those 65 and over, or about 2.7 million, and by 1935, 50 per cent (3, 8). With unemployment well over the 10 million mark in the depths of the depression, the burden of supporting aged relatives became impossible for many families. Private charity and pension plans proved useless before the magnitude of the task; many of the latter collapsed entirely. The decline in employment was more severely felt by the aged than by any other adult group; labor force participation among men 65 and over dropped sharply from 54 per cent in 1930 to 42.2 per cent by 1940 (1). At the same time, the number of aged 65 and over increased from 6.6 million and 5.4 per cent of the population in 1930 to

an estimated 7.5 million and 6 per cent in 1935.

During the five gravest years of the depression, when the plight of aged citizens had become extremely critical, the national government failed to meet their particular problem. It was not until late 1934 that a presidential committee was appointed to study problems of economic security. In this failure to act lay a major responsibility for the rise of independent action by the aged. From 1910 when the first national old age pension bill was introduced until 1930, Congress refused to consider such legislation. Committee hearings were held for the first time in 1930 and 1931, but no bill was reported to the floor of Congress. Favorable recommendations were granted pension bills in the next Congress, but none were submitted to a vote. In 1934, the fifth year of the depression, a national old age pension bill (S. 493) was approved by the Senate, which immediately rescinded its action in deference to the President's call for a special study on economic security.

State governments proved unable to cope with a problem that was national in scope. By the end of 1934 only 180,000 persons were receiving old age assistance; 28 states had enacted pension laws but three of these were inoperative. The population in 23 states was not protected by old age assistance.

A significant change occurred, meanwhile, in the composition and character of the dependent aged. Jobs having disappeared, businesses ruined and savings wiped out, an influx of despoiled professional men, retired farmers, skilled workers, and independent businessmen entered the ranks of the aged. These were the people who had attained a high degree of independence and economic security. The *laissez faire* philosophy, which had predominated during their lifetime, taught that the virtues of hard work and steady thrift were rewarded by an old age of comfort and security. The fact that the vast majority of Americans could not save placed these groups in a special position—for they had exemplified the rewards and beliefs in the prevailing system; they had proved it and, therefore, trusted and believed in it. Yet they too were as helplessly broken on the economic wheel as were their less fortunate brethren. These new accretions to the ranks of dependent aged represented a sensitive force receptive to protest thinking.

In the economic arena the aged possessed no bargaining position whatsoever. And in politics, the one sphere of action in which the influence of their numbers and votes could be felt, they were voiceless. The principal organizations advocating pension legislation remained isolated from the aged themselves; their efforts lacked the political dynamics of mass movements to whose symbols politicians must respond.

Certainly the political leaders and parties were aware of the existence of this socio-economical problem; the 1932 Democratic platform called for old age pension legislation through state action. Up to 1934, however, they were unaware of its political extent; they were not confronted with a threat to themselves. In light of the intrinsic nature of the American political system, it was only natural that the pressure group should occupy this political vacuum.

The American constitutional framework places a premium upon political action by groups independent of the major political parties. Its viability stems primarily from the separation of power principle incorporated in our governmental organization and from the nature of our major parties, each of which is a loose coalition of state parties and groups with divergent interests. Party leadership and responsibility, both within our bicameral legislatures and between executive and legislature, are extremely fragmentalized and party discipline negligible. Legislatures are characterized by fluid majorities, constantly changing and cutting across party and sectional lines. Individual legislators may with impunity defy party or Administration leadership without fear of undermining either or of incurring disciplinary action. Their party nomination and generally their election to office are autonomous

local affairs from which the national party organization and frequently the national platform are excluded.

Under such circumstances well organized, vociferous, special interest groups, entrenched in local communities, may intervene advantageously in both the electoral and legislative process. Major parties generally avoid the championship of new or unorthodox causes until the political viability of the latter has been assured. If dissatisfied or ignored in representation by parties, special interest groups may initiate independent action at all levels of the political process and in the local, state, or national arenas. If the major parties would not or could not incorporate within their politics protection for the aged, it was inevitable that such a large, unstable political element would find its expression in the pressure group or in the third party. Moreover, a separate division on the basis of old age alone was possible in the United States in the absence of fixed antagonistic divisions within our population.

A number of the new depression messiahs, principally Upton Sinclair and Huey Long, sought to make political capital out of old age discontent. Not only were they limited to restricted areas in their political operations, but their appeal to the aged, promises of $30 and $50 a month pensions to all over 60 years of age, was merely an incidental political tactic.

One minor pension promoter, Dr. J. E. Pope, tapped for a brief time the rich potential that lay in a specialized appeal to the aged. In proportion to the small size of his organization and the limited locale of operations, the response he evoked among the aged in the Southwest was astonishing (4). His program, however, offered nothing of particular attraction to capture the imagination of vast numbers of aged or of a large segment of the population, and Dr. Pope was early exposed as a fraudulent promoter with a criminal record. The aged were ripe for organization and politics, and as inadequate as his organization and efforts were, they could not but draw a response.

The full articulation of the aged came about through the efforts of Dr. Francis E. Townsend and the Townsend Movement which brought their interests into the highest political refinement and expressed them in typically indigeneous American fashion: money radicalism (a reliance upon monetary panaceas—cheap money, enforced spending—as the principal solvent for economic crises), the pressure group, and the third party. Only when despair of the aged assumed a threatening political form did the parties and political leaders weigh its strength and future in conjunction with their own.

Although somewhat peripheral, an additional factor might be cited as contributing to the inception of old age politics. The concentration of a large and extremely sensitive group of older people in a state characterized by weak political parties and a tradition of independent political action provided a fertile environment. In 1930 California, the nation's fifth most populous state, contained the fifth largest group of aged 65 years and over in the United States, 366,125. While it ranked eighth among the states with the highest proportion of aged, 6.4 per cent, none of these states contained more than a fifth the number of aged living in California, except Washington with less than a third.

The situation of these aged was one of recent migration to California, a high concentration within one area of the state, and a drastic deterioration in economic position. From 1920 to 1930 the population of the state increased over 65 per cent. At the same time its aged population, 65 and over, increased over 80 percent. In this decade the number of aged in the nation had increased by about 14 per cent. Not a single state approximated the rate of growth evidenced in California. These figures indicate an extremely high influx into California of older people from the rest of the nation. An even greater concentration occurred within the state, principally in Southern California; the number of people 65 and over increased by 100 per cent or more in Los Angeles and Long Beach and by over 90 per cent in San Diego and Pasadena.

Consequently, very few of the older people

in the state had resided there for any great length of time, most of them having arrived in the decade prior to the depression. For many important primary group ties had been severed, and for all an abrupt transition had occurred at a stage in life when readjustment is most difficult. At this unstable transitional period the depression caught the aged of California in a particularly exposed position. Many of the elderly had sought semi-retirement and easy living, bringing incomes with them rather than appearing as job seekers (22). During the depression pensions and savings were wiped out or frozen through the mass of bank failures, small marginal businesses failed, and the collapse of the stock market and the California real estate boom carried away the economic security of thousands of these new Californians. A large number of aged, recently concentrated in a small segment of a state, found themselves in extremely dire straits, bereft of their incomes and beyond the employable age.

The state itself provided a political atmosphere conducive to the rise of old age reform movements. In California, Crouch and McHenry (5) have shown that political parties are relegated to a meager and nominal role—impotent, ill-organized, and dishonored. Well organized and well financed pressure groups, as a consequence, have occupied an influential position, benefiting greatly from the availability of the initiative, referendum, and the recall. In terms of new political and economic revivals, Utopianism, Technocracy, E.P.I.C., this state became a western "burned-over" area.

The Townsend Plan, which appealed directly to the aged, started in Long Beach, within the solid Southern California community of aged. It promised to provide economic security for old people as well as to restore their former usefulness to society by making them the instruments for the economic recovery of the nation. Rapid initial expansion of the Townsend Movement was facilitated by the very large number of elderly people residing in this area. Aged Townsendites and their brethren were able to see immediate, concrete results in terms of increasing membership, financial contributions, publicity, *and* political recognition.

Without this concentration of a particularly unstable group of aged in a politically atomized community, the Townsend Movement might never have attained that initial impetus which fired it across California and into the other states of the nation. This is not to suggest that independent old age politics could not have been promoted elsewhere; Dr. Pope's Old Age Pension Association had been active when the Townsend Plan was initiated. However, special conditions in California launched a pension movement which succeeded in covering the entire country, one whose features and success stimulated the organization of additional pension movements throughout the nation.

Old age discontent and organization crystallized at a time propitious for social reform. The country had reached a stage of crisis wherein the *laissez faire* social philosophy had proved bankrupt; almost all groups within the population sought immediate aid from the national government which alone possessed the requisite powers and resources. National political leadership, moreover, had been transferred to a dynamic individual sympathetic toward social reform, whose operational philosophy incorporated a belief in the desirability for strong executive leadership, the need for immediate national action, the need for bold imagination and improvisation.

Certain reforms were more imperative than others and received top priority. As Francis Perkins (18) has pointed out, the political threat raised by the Townsend Movement forced the hand of the President—he had not intended originally to include old age protection within his program of social security in 1934-1935. However, the President believed it politically expedient at this time to recommend a reasonable alternative to the Townsend Plan.

Prospects For Future Old Age Politics In The United States

Does America face the prospect of a war of generations old, *vs.* young, as was recently sug-

gested by the economist for the American Medical Association (6)? Certainly many forces which have aggravated old age insecurity remain active today. In 1950 among persons 65 and over, 64.7 per cent resided in urban centers, a ratio higher than that for the general population. The proportion receiving earnings had declined to 30 per cent, representing in part a further reduction in employment opportunities for older people (1). At the same time, the aged 65 and over had increased by 86 per cent since 1930, numbering 12.3 million or 8.2 per cent of the population.

Since the aged comprise an ever increasing proportion of the eligible voters in the United States, what does this portend for social security politics? Will the aged again resort in large numbers to independent political action? Havighurst (11) has warned that if the aged group should ever form a solid political bloc, it could secure almost anything it might demand from the government. Old age movements of the depression decade, Clague (2) has contended, were in their political infancy in comparison to the pension movements of the future.

On the basis of a study of the Townsend Movement (14) from 1933 to the present and some of the corollary pension movements, I believe that such pessimistic hypotheses are largely unfounded. They reflect a lack of awareness that socio-political conditions have been so altered as to inhibit old age politics comparable to that of the depression decade.

The major political parties have adopted, as an integral part of their politics, favorable attitudes toward the social security system. One need only refer to the party platforms or to actions of Republican and Democratic leaders to comprehend the popularity of social security as a political issue. On the same day that the President of the United States labelled the Tennessee Valley Authority as an example of "creeping socialism" he praised the social security system and called for its expansion.

The American people have enthusiastically accepted the socialization of risk for old age, unemployment, and death. A political party would seriously penalize itself if it failed to reflect this sentiment. It can be expected, therefore, that the extension and liberalization of the present old age insurance and assistance programs will be championed by the major parties. Their leadership in the extension of protection for the aged will preempt that position which special pension movements have sought to monopolize.

An aggressive, influential labor movement now concerns itself with politics. Its leaders have committed themselves to a campaign, political as well as economic, to insure the future security of their members. Adequate pensions for the aged constitute a primary objective in their program of social reform. It was the economic espousal of organized labor and not independent political action by the aged which compelled a reconsideration of social security legislation in 1950. The brief success of George McLain's pension group in the California election of 1948 may be attributed in part to a favorable climate of public opinion generated by labor's agitation for old age security.

In contrast with the depression period when no national pension legislation existed, the social security system today protects millions of workers and their families. The latest extensions have included many of the self-employed and other groups previously excluded. Old age assistance, a joint federal-state project, is operative in all the states. Consequently, an ever improving system of protection removes much of the economic incentive that agitated old people to participate in pension movements. Their predicament can never again approximate the desperation and hopelessness which prevailed in the 1930's. A growing concern today with the socio-psychologic needs of older people promises to reduce the isolation in which many find themselves. Governmental, university, and private agencies are devoting themselves to research on all aspects of this problem.

To imply, however, that independent political action on the part of the aged may henceforth be ignored is as foolish as to suggest that it will increase in gravity. Old age pension move-

ments will continue to agitate American politics. Viewed in proper perspective, their political significance can be evaluated as minor.

National and state pension organizations remain active today. In many of these organizations clubs furnish a warm social environment for the old—opportunities for friendship, marriage, and a sense of belonging, avenues for leadership and respect. Participation provides meaningful activity enabling elderly people to feel that they retain a voice in society. Some pension organizations assist old people in obtaining their benefits under our complicated social security system. A major part of the appeal of the California Institute of Social Welfare has been its successful efforts to mediate between the aged and the complexities and impersonal qualities inhering in the administration of this system.

Certain states will continue to be active areas of pension politics. Revival of old age politics can be expected where a high concentration of aged is accompanied by a tradition of political unorthodoxy, an easy availability of the initiative for independent action, and a state of disorganization within the major parties. Such conditions are particularly characteristic of some of our western states; Florida, parts of New England and of the Middle West, which have had strong concentrations of Townsend Clubs as well as local pension movements, can also anticipate such activity.

Our social security system lends itself to continued pension politics as old age assistance focuses pressure upon state parties and legislatures. As long as needs tests, relative responsibility clauses, and other restrictions are imposed by state legislatures, they will generate discontent among our aged, many of whom consider pensions a matter of right, not need. In addition pension movements should find an attractive appeal in an espousal of medical benefits for the aged. The problem of maintaining health is a particularly acute one for old people as has been shown by the President's Commission on the Health Needs of the Nation (12).

In the event of an economic recession, it is unlikely that old age insurance benefits will be reduced, as major party leaders are well aware of the popular support behind social security. Old age assistance programs are more amenable to restriction; such action would presage a resurgence of independent politics in certain states. If inflation is again permitted to cut sharply into the real income of the aged, aggressive pension politics can be expected on the part of pension groups and unions. On the whole, however, alarming prospects for extensive old age politics envisioned by Clague, Dickinson, and Havighurst remain negligible.

Summary

This article attempts to deal with the following questions: 1) Why have the aged in the United States resorted to independent political action in contrast to an absence of such behavior elsewhere? 2) To what extent will the aged in our country continue to assume an independent role in politics? In countries of European culture, powerful labor and Socialist movements included old age pensions within their general programs of social reform, making special old age organizations unnecessary. The political environment, as well as culture patterns in which the aged retained status and respect in society, further inhibited such action.

Although urbanization and industrialization in the United States destroyed the security formerly found by the aged in a rural society, political and social institutions failed the old people. The proportion of aged people increased at a time when the economic system was restricting their opportunities to provide for themselves. A conjugal type of family, characteristic of our population, and an emphasis upon youth in our culture contributed to their isolation. On the political and economic scene the plight of the old people failed to secure any meaningful representation.

Under the impact of the depression the condition of the aged deteriorated radically with little if any compensatory social adjustment. Private and local governmental efforts proved useless. During the gravest period, no particular action was undertaken by the national

government to aid the older citizen, and nearly one-half of the states offered no old age assistance whatsoever. Under such circumstances many aged became susceptible to the appeals of new messiahs arising from the discontent of the times.

The American political system places a premium upon independent political action by special interest groups. In the absence of leadership from our major parties, the aged resorted to separate pressure politics. The Townsend Plan promised to restore them to a valued position in society, utilizing old age pensions to conquer the depression. Profiting from its inception in Southern California, where large and particularly unstable groups of aged were concentrated, the Townsend Movement gained sufficient organizational impetus to carry it across the nation. Under conditions propitious to the enactment of social reform, the threat of the pension movement compelled an immediate consideration and adoption of national old age pension legislation.

Are the aged to assume a more aggressive, independent political role in the future? It has been suggested by some authorities that we are threatened by such danger. In my opinion these conclusions are unwarranted; they ignore important socio-political changes which now constitute barriers to such action.

Our major political parties deem it imperative to espouse an expansion and liberalization of the old age security system. In addition, the present labor movement is committed to an aggressive pursual of such goals. Championship by such powerful and respectable proponents has considerably weakened the appeal of special interest groups to the aged. Moreover social security protection already covers a major portion of our population. The state of insecurity which characterized the aged during the depression decade and in which pension movements flourished can never reoccur. Governmental and private organizations, concerned with the socio-psychologic problems of the aged, are attempting to reverse the isolated position in which many find themselves.

Many old people will continue to be attracted to organizations advocating independent pension politics. Participation in pension organizations provides old people with opportunities for social activity and leadership roles. The social security system retains a number of features which expose it to pressure politics, especially upon the state level. States in which a high concentration of aged coincide with a weak party system and available instruments for independent action will be prone to pension politics. Especially is this to be expected if social security benefits are reduced or inflation is allowed to depress the real income of old people. Independent pension politics comparable to the 1930's, however, is highly unlikely on the national level or in most states.

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NEW GOALS FOR MATURITY

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Aspects of the Life Span

Studies of aging encompass the growth and development of the individual throughout the life span. Various tissues within the body have different time cycles of maturation apparently determined by their particular usefulness to the body economy. Cowdry (5) has demonstrated that within a single person the processes of aging act at different speeds. He has further shown that almost all the tissues of which the human body is composed is replaced by new material molded in the same shape. If the body could retain the same ability to resist disease and repair breakdown that it possesses at age 10, man would have an extended life expectancy.

Gerontology, according to Shock (13), is concerned with problems of growth, development, and maturation just as much as with atrophy, degeneration, and decline. In recent years these problems have taken on new importance because of the steadily growing number of older citizens. Atrophy and degeneration may be classed as the negative and growth, development, and maturation as the positive phases of the aging process. Atrophy may be due to disuse, and deterioration and decline are frequently the result of poor food, infection, and excessive wear and tear. In terms of prevention, if deterioration is limited the opportunity for maturation increases.

What Is Maturity?

The question, what is maturity, takes on new meaning. Are all oldsters mature? There is a suggestion of fulfillment in terms of durable satisfactions for the individual and greater stability for the social order, yet this is far from true for the vast majority of those who are living into the higher years of life. There is tremendous dissatisfaction and too much unhappiness in the lives of older men and women who should just be arriving at the optimum in terms of living.

The dictionary defines maturity as to be fitted by growth and development for any function appropriate to the species; to be fully prepared; ready for action. To be mature is to be brought by natural processes to completeness of growth. To be matured is to be fully developed or mellow with age, but not on the rigid side.

Brown (4) declared that to have a human life consist of an overlong period of mental infancy, a noisy middle age, and then a long period of enforced quiescence from which one is "relieved" by death—to make a life cycle mean nothing more than that, could be only the work of hellish monsters. Why chant about the glories of experience and then refuse to make use of them? Then, so he says, as if it were not inhuman enough to deny any recognized life to the graying, this coming of the period of inconsequence is held before them so long in advance that it paralyzes them before they have yet come up to the deadline. Citizens should not be hampered by such destructive attitudes. Life need not be a decline from youth onward. There are vast advantages in the years that belong with graying hairs provided the individual has not suffered arrested growth.

Gerontology then, should endeavor to crystallize a more satisfactory timetable in terms of growth and development to optimum maturity. If possible, even though they are not accurate, certain practical goals for maturity might be defined in terms of human potentials. Indeed, in addition to an IQ (intelligence quotient) and an EQ (emotional quotient) there is now need for an MQ (maturity quotient). This index of maturity would be helpful to employers and society in general. Particularly, it would be a record of an individual's capacity for per-

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formance, a complete health inventory in the most important period of an individual's life. Gerontology should begin to focus on the capabilities and aspirations of individuals whose lives are being lengthened through the majestic accomplishments of modern science. There is now a general awareness that age in itself is no deterrent to creative achievement.

More emphasis should be given to the positive aspects of aging. Optimum maturation of the individual and the control of premature deterioration should be the dominant chord in gerontologic research. Since aging has only recently attracted the scientist, the data for the most part are incomplete, and results so far are contradictory. Again, as Shock (13) has pointed out, the higher mental functions such as reason, critical thinking, and judgment do not lend themselves to quantitative measurement. New techniques need to be acquired and longitudinal studies concerning maturation are needed. None of these problems are unsurmountable. Science is now moving into this area which, according to Cannon, represents the most important frontier of human existence.

Maturity Components

Maturity, as pointed out by Binger (2), is not merely the opposite of immaturity nor can the concept of maturation be derived systematically. It is impossible to treat it as a scientific idea exclusively since it involves judgments of values. Such knowledge as we do have has been won largely by the use of analytic methods applied to the immature. Maturity, according to Binger, should be regarded as a psychobiologic process analogous to that of the fertilized ovum.

Biologic research is bringing forth information that should aid in preserving physical vitality well into the higher years of human existence. With healthier bodies and improved educational methods man should obtain a clear understanding of his own destiny.

In modern psychiatry a new science, that of psychodynamics, has appeared. In an analysis of mental health and personality disorders in selective service registrants, it was estimated that out of every 100 school children, 13 would fail to reach emotional maturity, 8 would be subject to emotional breakdowns, and 4 would end up in mental hospitals. Patients now the victims of mental disturbances, who occupy some 55 per cent of the nation's hospital beds, have a brighter hope for release from their bondage.

Gerontologic science must take cognizance of these recent important developments since the senior citizen is the end product of all that has gone before. As more years are being added to the life span, the preservation of the faculties is absolutely essential if life is to continue to have meaning.

The new fields of psychodynamics and psychoanalysis have brought out into the open previously hidden purposes behind behavior (7). Motivation has now become a major problem in normal and abnormal psychology. Whether we like it or not, as Kattsoff states (7), human behavior indicates direction. The driving forces of human existence are now coming within the sphere of objective analysis. This new insight into human nature is appearing on the horizon at the same time that atomic warfare is opening new channels of destruction. Kattsoff mentions that contemporary social phenomena cannot fail to recognize the tremendous importance of the values sought by members of society today. He believes that the goals toward which behavior is directed are subject to evaluation in the terms of health of individuals which makes the true social science. As social values spring from human values the stability of the social order is a reflection of the maturity or lack of maturity of the individuals which are its fabric. A social policy which is the result of mature minds should lead to a stable social order. The maturity concept then takes on social values as its validity is recognized.

It is now known that obstacles to emotional maturation may cause an arrest in an individual so that an adolescent mentality may exist in an adult. The criteria of maturity in older individuals have been discussed by Bond (3) and Saul (11). These authorities stress self re-

liance, productivity, flexibility, tolerance, moderation in mood, the ability to look ahead, the ability to live on the growing edge, religious orientation, and serenity. With years added to life there is more time available for growth. This is essential in order that a final vegetative existence be avoided. Maturity then, is a dynamic phenomenon, a continuation of growth as long as health and vitality exist. Present thought indicates that with health and vitality being preserved into the higher years more time for maturation becomes available.

In one of Shaw's essays (12), he makes the point that longer life is a necessity if mankind is to survive the present civilization. Much of the social illness today is the result of immature minds. Psychologic maturity is defined as the master concept of our time in a popular best seller, "The Mature Mind," by Overstreet (8). The maturity concept is central to the whole business of modern day life. It offers a solution for the confusions and despairs of the present day. The American Psychological Association has carried on important researches in this field. Psychology is now weighing methods of research to define the criteria of maturity.

The growth timetable may be divided into certain specific categories each of which under favorable conditions progresses through a developmental period to full maturity.

Physical maturity is defined anatomically as that period when the epiphysis and diaphysis of the long bones of the body fuse permanently. Physical growth is then completed. In lower animals there is a fairly close relationship between the period required to attain full body growth and the life span of the animal. For example, in the dog it takes two years for the shaft of the long bones to unite and the average span of life is 12 years, for the cat 1½ years and the average span of life is 9 to 12 years. A horse requires 2½ to 3 years for physical maturity and lives approximately 18 years.

If the human body attains physical maturity at approximately 25, the average span of human existence should approximate 125 to 150 years. Physical maturity is a relatively simple phenomenon and all that is required today is a well balanced nutritional program and unimpeded opportunity for normal growth.

Intellectual growth is systematized by our school systems. Progression from one grade to another in regular sequence may be followed through college into areas of research. Intellectual maturity is attained by a fully prescribed educational program. A high degree of literacy is a mark of an advanced culture.

For emotional growth there is not the well systematized progression which the schools furnish for intellectual development. This third phase of growth should proceed to emotional maturity described as the master concept of our time. Finally, spiritual maturation is characterized by understanding, tolerance, wisdom, and religious orientation.

The growth timetable for these components of human existence are not parallel. While there is overlapping, physical maturity would seem to be followed by intellectual, emotional, and finally spiritual fulfillment. Under optimum conditions, the growth of these interdependent components should enhance the maturation of the individual.

Iatrogenic Disease

Much poor health, suffering, and disease is self-induced. To name a few, obesity, high blood pressure, accidents, ulcers, physical and nervous exhaustion, alcoholism, and addiction to narcotics. The financial cost entirely apart from the human equation is a subject of much discussion, and elaborate programs for more and more medical care in preventable illnesses is a popular pastime. The nation's sickness rate could very well be reduced 50 per cent by a progressive and energetic prevention program using modern techniques and the information now available for the control of disease. Scientific knowledge in the mid-twentieth century is just now beginning to reveal the wonderful possibilities inherent in the human animal. Man's first job should be to rid himself of iatrogenic pathology. The point to be emphasized is that the underlying pattern of human

life is on a much grander scale than man himself has recognized.

Prelude to Longer Life

Increase in the human life span in the first half of the twentieth century has occurred so suddenly that society is incapable of handling the problems that have arisen with traditional methods of education and employment.

As the life span has advanced so has the age at which men are capable of leadership in the sciences, industry, and politics. The average professional man barely attains prominence before the age of 40. Accomplishment and leadership qualities are coming to the foreground later and later in life.

Educational programs for careers in the professions, industry, and other pursuits are being expanded and prolonged. The time of entering upon one's occupation has been pushed back more and more. Especially is this true of medicine. The timetable for professional training and experience essential for specialization make it all but impossible for a man under 35 to equip himself for service. This phenomenon would not be a hardship provided the period of productive activity is lengthened in accordance with individual ability and performance.

The significant development has been the protection of individuals against the vicissitudes which in times past threatened human existence in the early years. Our middle-aged population is now confronted with the possibility of deterioration due to faulty nutrition and elimination and prolonged exhaustion. Science, however, with atomic precision weapons is well on the way in search of knowledge concerning the genesis of vascular deterioration, cancer, and nervous and mental disorders. When these maladies are conquered another spectacular increase in the span of human life will take place. No one can predict how long it will be. Concentration of highly trained investigators on these problems offers a promise of rewarding discoveries within the next quarter century.

What will be the repercussion on society when biologic techniques uncover methods which will be able to alter the stature and mental capacity of individuals? It becomes all the more essential, therefore, for modern society and its leaders to predict in so far as possible what is coming and establish new ways for optimum development. Consideration of practical goals which will furnish the human body optimum opportunity for development leading to social stability is not beyond the function of a group such as our Gerontological Society.

Biologic Predictions

The biologic sciences have paid substantial dividends in man's quest for better kinds of fruits and vegetables, better fowl and cattle, faster horses, and human beings capable of living a considerably longer period of time than at the dawn of the twentieth century. The future of the race depends upon the production of healthier bodies and minds. Refinements of scientific methods with the use of radioactive isotopes, which now open an entirely new world to the scientists in their research to unravel the secrets of nature, may bring about knowledge of tremendous significance to the human race within the next twenty-five years.

In a thought-provoking article entitled, "Biology and the Burden of Our Times," Rostand (9) points out that until recently, biology had only one ambition; that was to improve the physical and moral state of sick or diseased persons. Biology aimed to correct, heal, and restore the individual to his normal capacity. Now, as Rostand points out, biologic science has become much broader in its investigation and more accurate with its techniques. It is turning its attention to the normal healthy individual and asking whether or not this normal man of the mid-twentieth century can be altered.

It has been known for some time that hormones and chemical substances are already available that will bring about far-reaching alterations in physical structure and behavior. The tracer technique with radioactive isotopes is going to add to our knowledge of nutrition and intermediary metabolism and the final spe-

cific destination of various foodstuffs in the body. The radioactive isotopes will also bring about a clearer understanding of the endocrine glands and the inter-relationships of the various organs within the body. A much better view of the circulation, the processes of the gastrointestinal tract, and other important functions of the body will become current information within the foreseeable future. Even voluntary determination of sex and parthenogenesis are possibilities. The point I would like to emphasize is that as animal husbandry and experimentation with various strains of fowl, cattle, horses, dogs, and other species, so human husbandry is beginning to loom as a tremendous potential for the alteration of the human race.

As an experimental animal, man is his own best object of study. The life span of rats and mice can be increased 30 per cent plus by specific feeding and moderate hygenic protection. Man, in spite of high accident rates, wars, and other man made pathology is at least beginning to expose himself to the possibility of longer life. He certainly wants to live longer, although many people ask why. The panorama of human existence is being markedly altered by material things and improved methods of communication and transportation. The cussedness of human nature is a persistent trait and seems able to withstand attempts for self-betterment.

New Goals For Maturity

This Gerontological Society is unique in its objectives. Its membership consists of a broad cross-section of the various scientific disciplines interested in aging. Studies of aging focus on individual growth and development. The tremendous complexity of the human animal adds to the difficulties of selecting specific phases of life processes which would suggest the most promising fields for investigations. Not the least of the difficulties is the isolation which has occurred as each scientific group has pursued particular problems further and further, complicated by techniques and formulae which other special groups have failed to understand.

The Gerontological Society offers an ideal forum for presentations concerning maturity in the most important period of human existence. To reach a clearer understanding of the total picture of living in the higher years, the experimentalist in the chemical laboratory must confer with his colleagues in other fields. Because of the social implications of increasing numbers of elder citizens, the physiologist, the physicist, and the biologist need to confer with the sociologist, the economist, the politician, and the philosopher.

In the present scientific program, for the first time a symposium on religious experiences of human beings is being presented as a major feature. It indicates recognition by a scientific organization of the powerful role religion exerts in human experience. Without such planning in the future the activities of the Gerontological Society will fall short of its objectives.

Gerontology is a little-understood term. It connotes much more than custodial care(housing) and arrangements for the primary needs of living. The medical profession thus far has demonstrated little enthusiasm for the study of the aged.

The new goals for maturity are toward a richer quality of physical existence, a higher degree of intellectual capacity, a deeper emotional enjoyment, and a more understanding spiritual experience during the time that is being added to human life. The new goals for maturity include a more rugged physical body capable of carrying through the latter decades of the 100 year span. This vitality will offer greater opportunity for intellectual development, emotional stability, and spiritual orientation.

It is interesting to note that medical education itself is at present undergoing a far-reaching study in an endeavor to make up for certain glaring deficiencies (1). Medical problems today are far different than those of twenty-five years ago, yet the curriculum has not evolved to meet the changes. The difficulty in the training of medical students today is the piecemeal approach, the high degree of concentration on isolated data with almost no correlation. There is much concern, and Berry, the Dean of Har-

vard (1), says that ways must be found to have students acquire a better understanding of the total patient in keeping with the mounting conviction that psychologic and environmental factors are of consequence in health and disease. Indeed, it would seem that the physician of tomorrow may be a medical sociologist.

Gerontology, as it emphasizes growth and development and the correlation of data concerning the physical and emotional maturation, must bring into close relationship previously isolated specialities. As the anatomist, physiologist, sociologist, and philosopher convene from time to time in a single forum to exchange ideas, the understanding of the problems of later life should be greatly clarified.

Workers Are Young Longer

In 1950 the Bureau of Employment Security of the U. S. Department of Labor (14) carried on an important study to define the nature and severity of the problems bearing on the employment of older workers. They investigated in detail the characteristics of our senior citizens and the hiring and retention practices of employers. Counciling and job placement methods were evaluated and problems of adjustment were surveyed. There was impressive evidence uncovered which emphasized the value of experience, knowledge, and know-how which only the older workers possess. In machine tool manufacturing, in which a high degree of accuracy is essential, the older employees are the dependable ones. Less restlessness was found among the older than among the younger groups of employees. There was less absenteeism among senior workers. In spite of all this, mature men and women are held at a considerable disadvantage in competition for employment. Evidence is all in favor of the older workers, yet current employment practices are against them. Antiquated age limits are still maintained by many industries. It is time that obstacles to the placement of older workers based on unfounded assumptions and bias be eliminated from current practices of American industry and professional life.

There is increasing dissatisfaction with the lot assigned by society to our elder population and they are beginning to get up in arms about the whole situation. We seem, according to Dickinson (6), to be moving away from a class-conscious society based on Marxian ideology and toward an age-conscious society in which the older voter may be expected to use his increasing voting power to extract what he can from the younger voter. In 1900 about 24 per cent of the eligible voters were 50 or more years of age; in the November 1952 elections more than 35 per cent of the eligible voters were over 50 years of age. Today, senior citizens by banning together may decide any election in their favor. It will be dangerous then if government moves from the idea of individual responsibility toward the doctrine of social responsibility with government supreme above the individual.

Accordingly, some perspective of the human life span should be examined with the thought of defending durable satisfactions for the individual and the society in which he moves. In order to develop the potentials of older citizens it now seems essential to re-examine the concept of maturity referred to by Shock (13), Overstreet (8), Binger (2), Saul (10, 11), and others. There is broad evidence that under present greatly improved living conditions for one-third of the world's population many people are enjoying an increase in the productive years, the mature years of life. In other words, they retain their vitality and interest into the higher years.

Summary

Gerontology is concerned with two phases of aging, problems of growth, development, and maturation, which are the positive aspects, and atrophy, degeneration, and decline, which represent the negative phases. The latter are concerned chiefly with the end result and deal clinically with the aged. The greater promise of gerontologic research must deal with growth, development, and maturation. As the period of optimum existence, that is, the middle years, is lengthened the dynamics of growth to optimum maturity take on new significance.

The concept of emotional maturity may well be the master concept of modern times. Studies in emotional maturation identify obstacles and also measures for optimum development.

As gerontologic research sharpens its focus on the positive qualities for improving the bodies and minds of growing adults, the individual and society will enjoy its greatest opportunity for life in the most important years.

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PUBLIC HEALTH SERVICE RESEARCH GRANTS AND FELLOWSHIPS, 1952

Grants for Studies on Aging[1]

Name	*Title*	*Amount*
Busse, E. W. University of Colorado, Denver	Effect of aging upon the central nervous system.	$7,532
Harlan, W. H. University of Florida, Gainesville	Department of Gerontology (Post Doctoral Fellow)	
Rahn, O. Idaho State College, Pocatello	A study of aging with bacteria as test organisms.	$8,640
Weinberg, J. M., and Havighurst, R. J. University of Chicago, Chicago	Mental hygiene for later maturity.	$2,948
Hick, F. K. University of Illinois, Chicago	Heat regulation of the aged.	$12,000
Scott, J. P. R. B. Jackson Memorial Laboratory Bar Harbor, Maine	Effect of age and strain on early behavior patterns.	$6,966
Pincus, G. Worcester Foundation Shrewsbury, Massachusetts	Steroids of aging men and women.	$10,000
King, J. T., and Visscher, M. B. University of Minnesota, Minneapolis	Studies of aging, diet, and adverse environmental factors.	$33,998 (for 2 years)
Lansing, A. I. Washington University, St. Louis	Cellular calcium binding in aging.	$11,826
Liddell, H. S., and McCay, C. M. Cornell University, Ithaca	Relation of aging to tolerance for environmental stress.	$28,638
Kallmann, F. J. Columbia University, New York	Genetics in aging mental illness.	$11,661
Simms, H. S. Columbia University, New York	Age alteration affecting death rate.	$29,916
Shorr, E. Cornell University Med. School, New York	Vasotropic factors in aging of the vascular bed.	$39,831
Kornzweig, A. L. Home for Aged and Infirm Hebrews, New York	The eye in old age.	$15,860
Mainland, D. New York University, New York	Age changes in bones and joints.	$7,182
Hamilton, J. B. Research Foundation of State University of New York, Brooklyn	Endocrine and metabolic factors in aging.	$11,718
Knutson, H. University of Rhode Island, Kingston	Effect of dieldrin on life span of *Drosophila.*	$1,000
Blandau, R. J. University of Washington, Seattle	Effect of ovum age on differentiation in the rat.	$8,000
	17 Projects 1 Fellow — TOTAL	$247,716

1,798 Grants in Total Program	$18,598,671
540 Fellows	$1,792,248

Aging Studies

1% of total number of grants
1.3% of total funds
0.2% of Fellowships

[1] From: Public Health Service Publication No. 289, U. S. Government Printing Office, Washington, D. C., 1953.

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GERONTOLOGIC RESEARCH IN DENMARK

TORBEN GEILL, M. D.

THE Danish Society for Research on Ageing has so far been a closed association of 15 medical superintendents of clinics and institutions. Recently it was decided, however, to admit new members, particularly young ones, in order to increase the activities of the Society.

In May, 1953, the Society held a joint meeting with the Danish Society for Internal Medicine where Professor H. Dam gave a detailed survey of the clotting mechanism of the blood on the basis of his own studies. He described various methods for determining the prothrombin activity, preparations used in anticoagulation therapy, K_1 preparations, and other agents with vitamin K effect. T. Geill submitted clinical studies (9) on clotting time, particularly in old age, discussing the factors which inhibit coagulation (antihistamines, alpha-tocopherol) and factors which promote coagulation (histamine). Injuries entailing hemorrhage in the tissues were followed by a temporary decline in the clotting time which was also demonstrable following injection of the patients' own blood. R. Friedberg (5) reported his comparative studies on the effect of ACTH on adrenal function in young and old persons. The adrenal parenchyma did not seem to be reduced in old age, but its manner of reaction was altered, the calcium balance in old individuals proving more stable than in young persons. The reverse applied to the blood sugar.

V. Porsman (23) reported the results of physical therapy in a geriatric department (De Gamles By in Copenhagen). The lesions which most frequently disabled the aged were osteoarthritis affecting the joints of the lower limbs, hemiplegia, rheumatoid arthritis, fractures, and the sequelae of fractures, Energetic physical therapy enabled a considerable proportion of the bedridden patients to be transferred from the hospital to nursing departments, departments for healthy residents, or to be discharged to their homes. The best results were obtained in the group of osteoarthritic patients. Out of 38 patients with osteoarthritis 31 could leave the hospital, and out of 32 patients with hemiplegia 17 could be transferred.

Danish gerontology has greatly benefited by the six-month appointments of a number of young physicians to the Washington University School of Medicine, Division of Gerontology, St. Louis. However, gerontologic research in Denmark suffered a great loss by the death of Dr. Niels Vinther-Paulsen on May 13, 1952. Dr. Vinther-Paulsen published a considerable number of papers on nutritive disturbances

NIELS VINTHER-PAULSEN, M. D.
1920 - 1952

in old age (27-31) as well as on other aspects of gerontology, but died before he had completed a large experimental study.

During the past few years De Gamles By (Old People's Town) in Copenhagen, the largest Danish institution for the aged, operated by the municipality of Copenhagen, has been undergoing modernization and in a few years will have facilities for 1800 old age pensioners. The approximately 800 relatively healthy residents will then all have single rooms, whereas about 400 patients in the nursing departments will be accommodated in double rooms. The capacity of the hospital proper will be about 600 beds as it is now. The new buildings are to contain well-equipped

laboratories, examination rooms, and a modern clinic for physical therapy. Research work in "De Gamles By" has also been extended, partly by grants from the newly established National Science Foundation, which made it possible to appoint additional laboratory technicians.

Since the report in the October, 1949, issue of the Journal of Gerontology, geriatric-gerontologic literature in Denmark has been augmented as follows:

A survey on "Geriatric diseases" (8) has been published by Geill in a textbook of clinical medicine for general practitioners. Geill and Kiær (6, 10) have submitted continued investigations into the changes of aging in the left atrioventricular fibrous ring. In most cases in which the ring was not yet calcified, microscopic examination showed characteristic changes manifesting themselves as a marked increase in fibrous tissue with ill-defined demarcation from the myocardium and extensions into the latter. The number of cellular nuclei was diminished, and major or minor precipitations of calcium were observed in the connective tissue. These changes must be interpreted as the precursors of calcification, and it is extremely likely that this thickening of the fibrous ring is a common cause of systolic murmurs in old age.

In a large autopsy material Bruzelius (3) found that about 20 per cent of all patients with infarcts in the anterior cardiac wall, 13 per cent of patients with infarcts in the posterior wall, and 17 per cent of patients with septal infarcts succumbed during the acute stage of the disease. Cardiac rupture was rather common in old age, particularly in cases of infarcts in the anterior wall, and the prognosis was most favorable for infarcts situated in the posterior wall.

Studies on anticoagulation therapy in thromboembolic conditions have been published by Lund (20). A total of 100 patients were treated with heparin-dicumarol, and the coagulability of the blood was controlled by the method advocated by Owren. In a subsequent paper (21) Lund discussed long-term dicumarol therapy, i.e., from 2 to 17 months. Complications were relatively slight, but the necessity of keeping the patients under constant medical supervision is emphasized. The treatment cannot be advised in general practice.

Vogelius and Bechgaard (32), studying the ocular fundi in persons with normal blood pressure, found constricted retinal arteries to be more common in the age group over 60 than in those from 40 to 60. A study of the eye ground changes in 500 individuals with hypertension of long duration was reported by Bechgaard and associates (2).

Modern views on the pathogenesis of arteriosclerosis were presented by Grüner and Hilden (12). In collaboration with Raaschou and Vogelius these authors (13) reported on heparin in the treatment of angina pectoris. Intravenous injections on heparin for periods of 3 to 4 months failed to reduce the frequency of the attacks.

In an effort to elucidate the pathogenesis of arteriosclerosis, Astrup and Grüner (1) determined the urinary excretion of hexosamine and glucuronic acid in young and old subjects. They found no difference, not even following treatment with ACTH.

Glavind, Hartmann, Clemmesen, Jessen, and Dam (11) studied lipid extracts from normal and atherosclerotic aortae for the presence of peroxides. While normal aortae did not contain lipoperoxides, peroxides were found in the lipid of all the specimens of atherosclerotic aortae examined. Furthermore, a correlation was found between the degree of atherosclerotic lesions and the peroxide value of the lipid in the aorta.

Faber and Lund (4) determined the dry weight, total cholesterol, and total calcium content of the intima and media of the aorta from 32 diabetic patients, 4 of whom had had normal blood pressure and 28 hypertension. No difference was found between the two groups, and the authors conclude that diabetes mellitus is not a factor in the development of aortic arteriosclerosis and that the calcification must be due to aging and blood pressure.

Wanscher, Clemmesen, and Nielsen (33) found atherosclerotic lesions to be less pronounced in patients with carcinoma than in non-cancerous persons (1835 autopsies). It is assumed that it is the cancer which influences the atherosclerotic lesion.

The effect of physical and mental stress on the development of atherosclerosis has been investigated by Hartmann and Schulsinger (15). The authors studied the incidence of atherosclerosis and the average age at death of members of Jewish families who had lived in Denmark during the last 45 years. A comparison was made between families who had lived in Denmark for several hundred years and families who had immigrated to Denmark during the last century. The same mortality from atherosclerosis was found for both groups in case of the men, whereas the age at death for the women succumbing from atherosclerosis was 6 to 7 years lower for women belonging to Jewish families more recently settled in Denmark.

Schmidt (24, 25) studied the urinary excretion of pantothenic acid in a large group of middle-aged and old subjects, determining both the spontaneous excretion and the excretion following intramuscular injection of 25 mg. of panthenol. The excretion was moderately reduced in old persons, presumably rather because of a diminished intake of food than because of a deficiency of pantothenic acid in old age. Achromotrichia and alopecia could not be ascribed to a lack of pantothenic acid.

Geill (7) discussed the urinary excretion of hormones and their split products (sex hormones, keto-

steroids, and corticoids). It is important to perform hormone analyses on persons who suddenly grow old and on persons with Morgagni's syndrome, senile anorexia, and adenomas of the adrenal cortex.

Friedberg (5) found that the reduction in ketosteroid and corticoid production which occurs with advancing age is a result of alterations in the adrenal cortex. Performing analyses before, during, and after treatment with ACTH the author concluded that the impairment of adrenal function is not due to a weakening of the adrenal parenchyma but presumably to a reduction in the function of the anterior lobe of the hypophysis.

Thyrotoxicosis in old age was studied by Iversen (16) on the basis of a series of 1832 patients admitted to the municipal hospitals in Copenhagen. Of these patients 9.8 per cent were over 60 years of age. The elderly patients had been suffering from the disease for lengthy periods before admission. Their basal metabolic rates were usually higher than in the younger patients and they had also lost more weight. Moreover, the elderly individuals exhibited a more oligosymptomatic form of the disease. A typical feature of this variety was the absence of exophthalmos and a more nodular form of goiter or even absence of palpable enlargement of the thyroid. The difference was most marked, however, in the case of cardiovascular disturbances, auricular fibrillation occurring in 25.5 per cent of the females and 22.0 per cent of the males over 60, whereas this sign was observed in 2.0 and 2.6 per cent, respectively, of the younger patients.

According to Meulengracht and Schwartz (22) stiff painful shoulder is most common in the age range 50 to 70.

A number of important nutritional studies were published by N. Vinther-Paulsen (27, 28, 29, 30). In a series of old persons who were mentally and physically debilitated and who had a poor appetite (500-1200 calories daily) he found emaciation, glossitis, anemia, hypoproteinemia, osteoporosis, and deficiency of the vitamins of the B group. This syndrome, which Vinther-Paulsen named senile anorexia, he ascribed to cerebral arteriosclerosis. In a subsequent paper he emphasized that the nutrition of elderly hospitalized patients should be carefully considered and that an adequate milk intake was important. At the Second International Congress of Gerontology in St. Louis, 1951, Vinther-Paulsen submitted a paper on calcium and phosphorus intake in senile osteoporosis. The calcium intake was examined by weighing the food for two one-week periods and calculated by the use of food tables. Among the patients who received less than 500 mg. of calcium per day the incidence of osteoporosis was 74 per cent compared with 21 per cent in the group with an intake above 500 mg. In the case of phosphorus the corresponding figures were 77 per cent and 9 per cent in the groups with intake below and above 900 mg. of phosphorus. The author considers a dietary deficiency of milk and cheese to be an essential cause of senile osteoporosis.

Simonsberg (26) emphasized the common occurrence of occult bleeding from the alimentary tract in old age. In the absence of malignant tumors or ulcers, he believes that the most likely cause is an increased permeability of the capillaries in the intestinal walls. In half the cases the hemorrhage could be arrested by oral administration of rutin (a flavone glucoside).

Kiørboe and Vinther-Paulsen (19) tried long-term treatment of senile dementia and glossitis in old age with large doses of vitamin B, especially nicotinamide and riboflavin. This did not, however, result in any improvement of the mental condition. The treatment was effective in only a few cases of acute confusion in which vitamin deficiency (pellagra) could be assumed to be responsible.

Kiørboe (17) studied the incidence of suicide in De Gamles By and found that during the period 1939 to 1948 only 35 suicides occurred among 7200 residents. The cause was not institutionalization, and neither did matrimonial conflicts, economic insecurity, or loneliness play an essential role.

As far as purely social publications are concerned, Kiørboe and Vinther-Paulsen (18) interviewed residents of De Gamles By and found that requirements regarding housing and other conditions of living had been fulfilled to a surprising extent and that the old people were on the whole satisfied. They emphatically stress the value of occupational therapy.

Haarløv (14) has dealt with the social care of the aged in Denmark. To a large extent the authorities have erected blocks with apartments for pensioners with a rent as low as $5.00 a month for a couple and $4.00 for single persons. About one-third of all municipalities in Denmark have built old age homes. Expenses for medical supervision are defrayed by the municipal authorities or are taken care of by membership at low cost. The aged are encouraged to continue working whenever possible by increased pensions for delayed filing.

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20. Lund, E.: Kontrol af antikoagulationsbehandling med Owren's metode til kvantitativ prothrombinproconvertin bestemmelse. *Ugesk. f. læger., 115:* 801-805, 1953.
21. Lund, E.: Langvarig dicumarolbehandling af coronarthrombose og andre thromboemboliske sygdomme. *Ugesk. f. læger., 115:* 805-809, 1953.
22. Meulengracht, E., and Schwartz, M.: Periarthrosis Humeroscapularis. Course and Prognosis of Seventy-Eight Cases. (Abstract) *J. Gerontol., 6:* suppl. to No. 3, 126, 1951.
23. Porsman, V.: *Physical Medicine in a Geriatric Department.* First Internat. Congr. Phys. Med., London, 1952.
24. Schmidt, V.: Excretion of Pantothenic Acid in the Urine in Young and Old Individuals. *J. Gerontol., 6:* 132-134, 1951.
25. Schmidt, V.: The Excretion of Pantothenic Acid in Patients with Achromotrichia and Alopecia. *J. Gerontol., 6:* 369--371, 1951.
26. Simondsberg, H.: Rutin ved occult melæna hos ældre. *Ugesk. f. læger., 114:* 971-973, 1952.
27. Vinther-Paulsen, N.: Glossitis as Indicator of Nutritional Deficiency in the Aged. *Rev. méd. Liège, 5:* 652-654, 1950.
28. Vinther-Paulsen, N.: Investigations of the Actual Food Intake of Elderly Chronically Hospitalized Patients. *J. Gerontol., 5:* 331-338, 1950.
29. Vinther-Paulsen, N.: Calcium and Phosphorus Intake in Senile Osteoporosis. (Abstract) *J. Gerontol., 6:* suppl. to No. 3, 163, 1951.
30. Vinther-Paulsen, N.: Senile Anorexia. *Geriatrics, 7:* 274-279, 1952.
31. Vinther-Paulsen, N.: Glossitis and Epithelial Atrophy in Old Age. *Internat. Rev. Vitamin Res., 24:* 148-154, 1952.
32. Vogelius, H., and Bechgaard, P.: The Ophthalmoscopical Appearance of the Fundus Oculi in Elderly Persons with Arteriosclerosis and Normal Blood Pressure. *Brit. J. Ophth., 34:* 404-408, 1950.
33. Wanscher, O., Clemmesen, J., and Nielsen, A.: Negative Correlation Between Atherosclerosis and Carcinoma. *Brit. J. Cancer, 5:* 172-174, 1951.

De Gamles By, Norre Alle 41, Copenhagen, Denmark.

GERONTOLOGY IN THE UNITED KINGDOM

V. KORENCHEVSKY

In previous papers (*J. Gerontol., 6: 275-287, 1951; 7: 504, 1952*) all the main data on the organisation and activity of the existing British Societies and laboratories engaged in gerontologic work were given. In this report only further development or changes in their structure or activity and newly established centres of gerontologic work are described. Information has not yet been received from all the laboratories engaged in gerontologic work, but these data will be given later.

Lord Nuffield.—Lord Nuffield has continued to be actively interested in gerontologic research work. His new donations were made to the Conference of the European Division of the Research Committee of the International Association of Gerontology and to the Third Congress of this Association; also grants for travelling expenses were given to the British delegates to the Second International Gerontological Congress in St. Louis and to the Hon. Secretary of the British Society for Research on Ageing.

For the development of gerontology in the United Kingdom not only Lord Nuffield's personal donations and the establishment of his Nuffield Foundation were important, but also the fact that behind the pioneering work in establishing a new science of gerontology was a man who, because of his abilities, arose from the status of a poor workman to become one of the wealthiest kings of industry. For those who know Lord Nuffield personally it is clear that his deeprooted interest in medical research work explains his many donations for this purpose. In recognition of his services to gerontology, the Organising Committee of the Third International Gerontological Congress has asked him to be the Patron of the Congress.

The Nuffield Foundation.—In 1953 the Foundation started to assist gerontologic research in the United Kingdom on a large scale. A substantial grant was extended to the Research Unit into Problems of Ageing in Cambridge University. Two large renewable Nuffield Gerontological Research Fellowships, involving in the first instance a total grant of £51,000, were established.

A senior Fellowship was given for five years to Birmingham University for Dr. P. L. Krohn, Reader in Endocrinology. His programme of research is aimed at the study of the interactions of tissues and their environment with aging and an investigation of the factors controlling the duration of reproductive life in primates.

A Fellowship of lesser status was given for three years to Leeds University for Dr. D. A. Hall, Lecturer in Biochemistry, who proposes to study the changes in the connective tissue with aging.

Lesser grants, for two years each, were made to Dr. A. Comfort in the Department of Zoology, University College, London, for studies in the biology of aging, and to Dr. G. P. Xuereb in the Nuffield Department of Surgery in Oxford University for investigation of the changes in the pattern of blood-vessels during the process of aging.

A large grant was again given to the National Corporation for the Care of Old People. The Foundation's previous contribution to this Corporation was £500,000, and another grant of £250,000 was given for the next five years.

The Foundation is also supporting an inquiry into the social aspects of the continued employment of elderly workers.

The British Society for Research on Ageing.—The new address of the headquarters is the Courtauld Institute of Biochemistry, The Middlesex Hospital, London, W. 1. Professor E. C. Dodds, M.D., F.R.S., is the Chairman of the Society; Dr. V. Korenchevsky its Hon. Secretary.

The Society's recent work includes the organisation of a branch for research in social and industrial medicine and the socio-economic aspects of the problems of aging.

In 1953 the Society can look with satisfaction on the great international development of gerontology, the organisation of which was started in 1939.

The Medical Society for the Care of the Elderly.—The President of the Society is Lord Amulree, the Hon. Secretary is Dr. H. P. Jameson, Romeland Cottage, St. Albans, Herts.

The Society is growing, and at present its membership is between 120 and 140. The Executive Officers of the Society would like to prepare a detailed statement about its activity, which will be published in a subsequent issue of the Journal of Gerontology.

The Oxford Gerontological Research Unit.—The first Head of the Unit, Dr. V. Korenchevsky, retired from its directorship in November, 1953, having found, before his retirement, permanent headquarters and a new director for the Unit, since it was impossible to incorporate the Unit into Oxford University. After careful consideration of various proposals, the Executive Committee of the British Society for Research on Ageing (which is simultaneously the Governing Body of the Unit), at the suggestion of Dr. Korenchevsky, transferred the Unit to the Department of Physiology of the Medical College of St. Bartholomew's Hospital, London University, which

offered permanent headquarters to the Unit. Prof. K. J. Franklin, M.D., D.Sc., became the Director of the Unit.

Dr. V. Korenchevsky, however, will continue his gerontologic research work in the Whittington Hospital, St. Mary's Wing, Highgate Hill, London, N. 19. In connection with this, it is significant for the present official attitude to gerontology that both the Senior Medical Officer of the Regional Hospital Board, Dr. H. M. C. Macauley, and the Medical Superintendent of the Whittington Hospital, Dr. C. Coyle, welcomed an experimental gerontologic laboratory into their hospital in addition to the already existing geriatric unit.

Besides the publications referred to in the previous report, further papers were published from the Oxford Unit:

By V. Korenchevsky:

1. Endocrines and Aging. Report of the New York State Legislative Committee on Problems of Ageing, pp. 120-128, New York, 1952.
2-3. Gerontology in the United Kingdom. J. Gerontol., *6:* 275-287, 1951, and *7:* 504, 1952.
4. The International Association of Gerontology and Rapid Progress of Gerontology. Brit. Med. J., *i:* 375-376, 1952.
5. Proceedings of the Research Session on Endocrinological Aspects of Ageing (Second International Gerontological Congress). J. Gerontol., *7:* 291-307, 1952.
6. The Research Committee in the Organisation of the International Biological and Medical Associations and their Congresses. Science, *118:* 361-362, 1953.

By V. Korenchevsky, S. K. Paris, and B. Benjamin:

7. Effects of Castration and the Processes of Aging in Male Rats and Man. J. Gerontol., *8:* 6-32, 1952.
8. Treatment of Senescence in Male Rats with Sex and Thyroid Hormones and Desoxycorticosterone Acetate. J. Gerontol., *8:* 415-434, 1953.

By V. Korenchevsky, L. Brull, and A. P. Thomson:

9. Proceedings of the First Conference of the European Division of the Research Committee on Biology and Medicine. J. Gerontol., *6:* 111-112, 1953; J. Am. Geriat. Soc., *1:* 72-76, 1953.

Three more papers are being prepared for publication.

The Nuffield Research Unit into Problems of Ageing.—Address: Department of Psychology, Cambridge University; Hon. Director, Sir Frederick Bartlett, Director, Dr. A. T. Welford. Most of the research performed was concerned with the changes with aging in the speed and accuracy to various degrees and types of complexity of task. The following papers or books were published:

By A. T. Welford:

1. Skill and Age: an Experimental Approach. Oxford Univ. Press, for the Nuffield Foundation. Oxford, 1951.
2. Problems of Middle Age. Health Education J., *9:* 167-171, 1951.
3. An Electronic Digital Recording Machine—the SETAR. J. Sci. Instrum., *29:* 1-4, 1952.
4. The "Psychological Refractory Period" and the Timing of High-speed Performance—a Review and a Theory. Brit. J. Psychol., *43:* 2-19, 1952.
5. An Apparatus for Use in Studying Serial Performance Am. J. Psychol., *65:* 91-97, 1952.
6. Changes in Human Performance with Age. Tr. A. Indus. Med. Off., *2:* 78-82, 1952.
7. Changes of Physical and Mental Skills with Age. Advanc. Sci., *9:* 412-416, 1953.
8. The Psychologist's Problem in Measuring Fatigue. Ergonomics Research Society: Symposium on Fatigue. H. K. Lewis, London, pp. 183-191, 1953.

By Sir Frederic Bartlett:

9. The Employment of the Older Worker. Ministry of Labor Centenary Lectures. H. M. Stationary Office, London, pp. 80-87, 1952.

By H. Kay:

10. Learning of a Serial Task by Different Age Groups. Quart. J. Exper. Psychol., *3:* 166-183, 1951.

By H. Kay and E. C. Poulton:

11. Anticipation in Memorising. Brit. J. Psychol., *42:* 34-41, 1951.

By J. Szafran:

12. Changes with Age and with Exclusion of Vision in Performance at an Aiming Task. Quart. J. Exper. Psychol., *3:* 111-118, 1951.

By H. F. King and D. Speakman:

13. Age and Industrial Accident Rates. Brit. J. Indus. Med., *10:* 51-58, 1953.

By W. T. Singleton:

14. Deterioration of Performance on a Short-term Perpetual-motor Task. Symposium on Fatigue. H. K. Lewis, London, pp. 163-172, 1953.

By G. F. Adams and A. T. Welford:

15. Some Social and Psychological Problems of Ageing. Nature, *171:* 422, 1953.

The Edinburgh Group of Research on Arteriosclerosis.—A committee was formed at Edinburgh University consisting of the representatives of the Departments of Medicine, Pathology, Biochemistry, and Chemistry and cooperating with the Edinburgh Gerontological Research Unit to study the nature and causes of arteriosclerosis (Chairman, Dr. C. P. Stewart, Department of Biochemistry, Royal Infirmary, Edinburgh). The research being carried out in the Unit takes the form of the experimental feeding of various fats to rats in order to determine which, if any, produce pathologic, in particular arteriosclerotic, changes in the cardiovascular system.

Dr. Geiringer retired from the Gerontological Research Unit; Prof. F. A. E. Crew remains its Director.

The Leeds Gerontological Research Group.—This group is composed of the Department of Medicine of Leeds University (Director, Prof. R. E. Tunbridge), the Nuffield Foundation Research Fellowship in the University Department of Biochemistry (Dr. D. A. Hall in charge), and the Geriatric Unit of St. James's Hospital (Dr. H. Droller in charge). Prof. Tunbridge was the initiator and organiser of this informal research centre, which has become an important component of British gerontology.

Since the previous report, gerontologic work in the Department of Medicine of the University of Leeds has been proceeding along the lines outlined in that statement. The Unit has been studying in particular the fundamental structure of elastin as a component of a variety of tissues, especially the human aorta

and the ligamentum nuchae of the ox. During this period the work has been carried on under the direction of Prof. R. E. Tunbridge by 2 academically qualified and 2 technical staff investigators. The Unit has had considerable assistance and collaboration from Dr. H. Rein first in the Department of Biomolecular Structure and later in the Department of Leather Industries. After January 1, 1954, the progress of this work should be greatly increased by the appointment of Dr. D. A. Hall to the Nuffield Gerontological Research Fellowship. He will have funds which should enable him eventually to have the assistance of 1 senior and 2 or 3 junior academic staff and 4 technical assistants. The programme of proposed research will remain much the same as in the past but it is hoped that a more generalised study can be carried out on the changes associated with aging as they will affect other constituents of connective tissue in addition to elastin, which has hitherto been the main concern of the Unit.

The following papers were published:

From the Department of Medicine of Leeds University:

By R. E. Tunbridge, R. N. Tattersall, D. A. Hall, W. T. Astbury, and R. Reed:

1. The Fibrous Structure of Normal and Abnormal Skin. Clin. Sci., *11:* 315-331, 1952.

By R. E. Tunbridge, W. T. Astbury, R. Reed, D. A. Hall, and R. N. Tattersall:

2. The Effect of Aging on Elastin and Collagen Fibres: Structural and Chemical Studies (Abstr.). J. Gerontol., *6* (suppl.): 159, 1951.

By D. A. Hall:

3. Elastin from Human Tissue and from Ox Ligament. Nature, *168:* 513, 1951.
4. Various Elastin Preparations as Substrates for Elastase. Abstr. 2nd Congress of Biochemistry, p. 292, 1952.
5. Studies on the Complex Nature of Elastase. Biochem. J., in press, 1953.

By D. A. Hall, R. Reed and R. E. Tunbridge:

6. The Structure of Elastic Tissue. Nature, *170:* 264-266, 1952.

By G. C. Wood:

7. The Stabilisation of Elastin by a Polysaccharide. Biochem. J., in press, 1953.

From the Geriatric Unit of St. James's Hospital:

By Dr. H. Droller:

1. Foliandrin in Geriatric Practice. Cardiologia, *22:* 118-124, 1953.
2. The Intra-Arterial Injection of Priscol in the Management of Senile Arterial Obstruction. Cardiologia, *22:* 247-253, 1953.

The Northern Group of Gerontological Research consists of three independent parts, cooperating in certain research projects—the Department of Pathology (Director, Prof. J. B. Duguid, M.D.), the Department of Psychiatry (Director, Prof. A. Kennedy, M.D.) of Durham University, and the Geriatric Unit of the General Hospital, Sunderland (Director, Dr. O. Olbrich).

Prof. Duguid continues his studies in the pathogenesis of arteriosclerosis and emphysema, while Prof. Kennedy has started research on psychosomatic relations in the problem of mental inefficiency in the elderly.

It is necessary to emphasize the continuous development of the Sunderland Geriatric Unit. In a comparatively short time Dr. Olbrich succeeded in establishing efficient clinical and biochemical laboratories in his Unit, continued some previous investigations, and started new ones. At present the Unit is engaged in research on the renal function in prostatism, the cardiac output and cerebral blood-flow in the aged, and the electrolyte-water balance in old age.

This development of the Unit was only made possible by the assistance of Dr. W. G. Patterson, the Senior Administrative Medical Officer of the Newcastle Regional Hospital Board, and his vision and understanding of the great importance of fundamental geriatric research.

The following papers were published:

From the Dept. of Pathology of Durham University:

By J. B. Duguid:

1. Thrombosis as a Factor in the Pathogenesis of Coronary Atherosclerosis. J. Path. & Bact., *58:* 207-212, 1946.
2. Thrombosis as a Factor in the Pathogenesis of Aortic Atherosclerosis. J. Path. & Bact., *60:* 57-61, 1948.
3. The Arterial Lining. Lancet, *ii:* 207-209, 1952.

By J. B. Duguid and G. S. Anderson:

4. The Pathogenesis of Hyaline Arteriosclerosis. J. Path. & Bact., *64:* 519-522, 1952.

From the Sunderland Geriatric Unit:

By O. Olbrich:

1. Methods of Investigating Renal Function. Ztschr. f. Klin. Med. u. Kinderh., *136:* 119-120, 1952.
2. The Process of Ageing. The Medical Press, in print, 1953.

By O. Olbrich and E. Woodford Williams:

3. Precordial Electrocardiogram in the Aged. Pub. Health Rep. U.S.A., *67:* 137, 1952.
4. The Normal Precordial Electrocardiogram in the Aged. J. Gerontol., *8:* 40-55, 1953.
5. The Effect of Change of Body Position on the Precordial Electrocardiogram in Young and Aged Subjects. J. Gerontol., *8:* 56-62, 1953.
6. Renal Function in the Aged. Bull. méd., Paris, in print, 1953.

By O. Olbrich and A. Kennedy:

7. Relation of Metabolic Imbalance to the Reversible Psychotic Incidence of Old Age. Bull. méd., Paris, in print, 1953.

The Department of Social and Industrial Medicine, Sheffield University, Sheffield.—Director, Prof. W. Hobson, M.D. The Department was established in 1949 for research in the medical, biologic, and sociologic aspects of aging. At first a socio-medical survey of 476 elderly persons, living in their homes in the Sheffield area, was carried out. A recent investigation comprises a similar survey of the British iron and steel industry with several thousands of male workers. At present the results obtained in these surveys are being prepared for publication. Besides Prof. Hobson, 2 lecturers of the Department, J. Pemberton, M.D. (senior), and C. E. Fleming, M.A. B.A., 2 statisticians, R. F. Wrighton, M.A., and C. Roseman,

B.Sc., and some temporary workers are engaged in this work.

The following papers were published:

By W. Hobson:
1. Problems of Old Age. Sheffield Univ. Gaz., *11:* 4-5, 1951.
2. The Employment of Old Persons in Industry. Tr. A. Indus. Med. Off., *1:* 133-139, 1951.
3. The Care of the Elderly Sick and the Associated Problems of Chronic Illness. Report of the Geriatric Advisory Committee to the Sheffield Regional Hospital Board, Sheffield, 1951.

By W. Hobson and E. K. Blackburn:
4. Haemoglobin Levels in a Group of Elderly Persons Living at Home alone or with Spouse. Brit. Med. J., *i:* 647-649, 1953.

By W. Hobson and C. Roseman:
5. A Dental Survey of a Group of Old People Living at Home. Brit. Dent. J., *94:* 208-212, 1953.

By J. Pemberton:
6. The Return to Work of Elderly Male Hospital In-Patients. Brit. Med. J., *ii:* 306, 1949.

By H. Droller, J. Pemberton, C. Roseman, and J. L. Grout:
7. High Blood Pressure in the Elderly. Brit. Med. J., *ii:* 968-970, 1952.

By H. Droller and J. Pemberton:
8. Cardiovascular Disease in a Random Sample of Elderly. Brit. Heart J., *15:* 199-204, 1953.

By C. E. Fleming:
9. Interim Report on Industrial Age-Analysis—Sheffield Iron and Steel Industry. (Private circulation) i-ix, 43 pages, Sheffield, 1952.
10. The Employment of the Elderly in Industry. Brit. J. Phys. Med., *16:* 75-78, 1953.

By D. L. Woodhouse:
11. Pensions are not Enough. Indus. Welf., *32:* 89, 1950.
12. Old People, Their Use and Knowledge of the Statutory Social Services. Almoner, *5:* 521-527, 1953.

By K. E. Manning and R. F. Wrighton:
13. Investigations on the Relationship Between the Ages of Individuals and the Agglutinability of Their Red Blood Cells. J. Lab. & Clin. Med., *39:* 198-201, 1952.

The Department of Morbid Anatomy, University College Medical School, London. Director, Prof. G. Cameron.

G. Loewi. Changes in the Ground Substance of Ageing Cartilage. J. Path. & Bact., *65:* 381-388, 1953.

The Geriatric Committee of the Royal Medico-Psychological Association.—Chairman: Dr. W. S. Maclay, Ministry of Health, Savile Row, London, W.1; Hon. Secretary: Dr. W. L. Rees, Four Elms, Rhiwbina, Cardiff. Since its formation early in 1951, the Committee has met at regular intervals and has dealt with a number of subjects concerning mental disorders in elderly people. The following subjects have been extensively studied:

1) Prognosis of mental disorders in elderly patients.
2) Differences in mortality of men and women suffering from psychosis in old age.
3) Classification of mental disorders in old age.

At present an extensive investigation is in progress in various parts of England and Wales on the cause and outcome of mental disorders in old age. These investigations are being carried out by Dr. Roth at Chichester, Dr. McCowan at Dumfries, Dr. Cooke in Kent, and by Dr. Rees in Wales.

The Geriatric Unit at the Whittington Hospital, London, N.19, Director, A. N. Exton Smith, M. D. A well organised Unit was established at the Whitington Hospital in 1951. In addition it has an excellent Home with extensive gardens for old people in which they remain under medical supervision for some time after discharge from the Hospital.

The following papers were published from this Unit:

By A. N. Exton-Smith:
1. The Hospital and Domiciliary Care of the Aged Sick, with Particular Reference to the Ecology of Old Age. Thesis, Cambridge University, 1951.
2. An Investigation of the Aged Sick in Their Homes. Brit. Med. J., *ii:* 182-185, 1952.

By A. N. Exton-Smith and G. S. Crockett:
3. The Chronic Sick Under New Management. Lancet, *i:* 1016-1018, 1949.
4. Physical Medicine in the Treatment of the Aged Sick. Brit. J. Phys. Med., *13:* 73-78, 1950.

By A. N. Exton-Smith, Lord Amulree, and G. S. Crockett:
5. The Proper Use of the Hospital in the Treatment of the Aged Sick. Lancet, *i:* 123-125, 1951.

The Geriatric Unit of Southampton General Hospital, Director, Dr. E. B. Brooke. The unit was established in 1953 and has 406 beds and 3 physicians. Dr. Brooke plans to do clinical geriatric research.

The Geriatrics Units Listed in the Tables of the Previous Papers (J. Gerontol., *6:* 286, 1951 and *7:* 504, 1952).—From most of these Units information has been received as to some recent and possible future alterations in the number of physicians and patients. For economy of space new tables with these corrected data are not included in this report, but will be tabulated in the next. It is possible to state, however, that geriatric units are growing and developing. In the following list, changes of directors or physicians in charge of the Units are given, and also the publications from the Units are recorded since they indicate the growing interest in geriatric research, at the same time representing the present status of geriatrics in the U. K.

Foresthall Hospital's Geriatric Unit, Glasgow. Director, Dr. W. F. Anderson.

St. Helier Hospital's Geriatric Unit, Carshalton, Surrey (190 beds, 7 physicians). Director, Dr. W. N. Rogers.

Dr. I. H. K. Stevens is Consultant in charge of *Geriatrics in East Kent,* supervising besides Nunnery Fields Hospital (136 beds), 6 more hospitals with a total of 729 beds. Address: Kent and Canterbury Hospital, Canterbury.

The following are the publications from the Geriatric Units:

Barncoose Hospital:
1. Geriatrics—Modern Developments. Bristol Med.-Chir. J., *68:* 38-42, 1951.
2. Organisation of a Geriatric Service in a Rural Area. Lancet, *i:* 785-789, 1952.

Belfast City Hospital:

By G. F. Adams:

1. Geriatrics in Northern Ireland. Lancet, *11*, 1095-1097, 1949.
2. The Social Medicine of Old Age in Northern Ireland. Ulster Med. J., *21:* 130-141, 1952.
3. Long-Stay Accommodation for the Elderly Irremediable Patient. Ulster Med. J., *21:* 177-184, 1952.
4. Old Age in the Modern World. Advanc. Sci., *9:* 405-409, 1953.

By G. F. Adams and S. G. McComb:

5. Assessment and Prognosis in Hemiplegia. Lancet, in print, 1953.

By G. F. Adams and E. A. Cheeseman:

6. Old People in Northern Ireland. Report to the N. Ireland Hospitals' Authority on the Medical and Social Problems of Old Age. Belfast, 1951. The book contains 95 pages of text and 106 pages of appendices, including 43 detailed tables. All the data were statistically analysed and an excellent and detailed picture of the medical and social conditions of old people in Northern Ireland is presented. Geriatricians will read this book with great interest.

St. John's Hospital, London, S.W. 11:

By T. H. Howell:

Some Clinical Uses of Tetraaethylammonium Bromide. Practitioner, *167:* 641-642, 1951.

By T. H. Howell and A. P. Piggot:

Morbid Anatomy of Old Age. Geriatrics, *8:* 215-218; 267-272, 1953.

Nottingham City Hospital:

By W. Morton:

1. A Geriatric Unit in a General Hospital. Brit. Med. J., *ii:* 715-718, 1952.
2. The Elderly Patient. Physiotherapy, *39:* 3-7, 1953.

The Welfare Corporation and Societies described in the previous report.—These have continued to be engaged in the same efficient and manifold work for the care and welfare of old people and are becoming an indispensable and permanent institution in this very difficult work in this country.

Summary

Concluding this survey of the period from 1951 to 1953, it is possible to state that all branches of gerontology have been steadily developing in the United Kingdom, including experimental and clinical fundamental research and socio-medical work. The Nuffield Foundation is of especial help in this development, while those Regional Hospital Boards, which have already extended their assistance to research work on aging in their geriatric units, suggest a new and important period in the gerontologic policy of governmental bodies.

Gerontological Research, Whittington Hospital, St. Mary's Wing, Highgate Hill, London, N. 19, England.

SUMMARY OF THE MINUTES OF THE EIGHTH ANNUAL MEETING OF THE COUNCIL AND MEMBERS OF THE CORPORATION OF THE GERONTOLOGICAL SOCIETY, INC.

THE meeting was called to order at 1:50 p.m. on August 25, 1953, in the Bonanza Room of the Mark Hopkins Hotel, San Francisco. Members of the Council present were E. V. Cowdry, N. W. Shock, J. E. Kirk, W. Andrew, A. I. Lansing, E. J. Bortz, O. J. Kaplan, C. Tibbitts, and E. W. Burgess. Absent were A. J. Carlson, R. A. Moore, G. F. McCoy, and G. Bugbee. Wilma Donahue was also present.

Reports of the Secretary, Treasurer, Editor-in-Chief and the budget for 1954 were presented and accepted. Reports of the Membership Committee, the Committee on Qualifications for Fellowship Status, the Committee on Affiliate Organizations, and the Nominations Committee were presented and approved.

The following actions were taken:

The Editor-in-Chief of the Journal of Gerontology was authorized to increase the proportion of costs for tabular matter and engravings to be paid by the Journal, thus reducing charges to authors publishing papers in the Journal.

The establishment of a Newsletter to be sent to all Fellows and Members of the Society was approved. For 1954, this Newsletter will consist of four pages, issued on a quarterly schedule. A Committee, consisting of O. J. Kaplan, chairman, Wilma Donahue, C. Tibbitts, J. E. Kirk, and N. W. Shock, was appointed by Dr. Cowdry to draw up a statement of editorial policy, to survey publication costs, and to prepare material for issues to be published in 1954.

General members of the Society may elect to receive the Newsletter in lieu of the Journal of Gerontology. This option is not available to Fellows.

A contribution of $50.00 to the National Society for Medical Research was approved.

Renewal of the bond for the Treasurer and Assistant to the Editor on the present basis was approved.

It was suggested and approved that an opportunity be given for Divisional Meetings during the Annual Meeting of the Society.

It was recommended that the Seventh Annual Scientific Meeting of the Gerontological Society, Inc., be held in Gainesville, Florida, and the Eighth Annual Scientific Meeting in Ann Arbor, Michigan.

Dues for 1954 were maintained at $10.00 for Fellows and Members receiving the Journal. General Members (but not Fellows) may elect to receive the Newsletter in place of the Journal at $2.50 per year.

N. W. SHOCK
Secretary

SUMMARY OF THE MINUTES OF THE SIXTH ANNUAL MEETING OF THE GERONTOLOGICAL SOCIETY, INC.

THE meeting was called to order at 4:40 p.m., August 26, 1953, in the Peacock Court of the Mark Hopkins Hotel, San Francisco. Dr. E. V. Cowdry, President of the Society, acted as Chairman and N. W. Shock served as Secretary.

Dr. Cowdry presented a report of the Council meeting. The appreciation of the Society to the Forest Park Foundation for financial aid to the Journal of Gerontology during the past year was expressed.

The report of the Membership Committee showed that 162 new members joined the Society in 1953. There were 5 deaths, 39 resignations, and 41 in arrears in dues for two years, leaving a total of 950 members in good standing as of August 1, 1953.

It was voted to hold the Seventh Annual Scientific Meeting of the Gerontological Society in Gainesville, Florida, and the Eighth Annual Scientific Meeting in Ann Arbor, Michigan.

The following officers and members of the Council were elected:

President	Anton J. Carlson
President-Elect	Ollie A. Randall
Secretary	Nathan W. Shock
Treasurer	John Esben Kirk
Council Members:	
Biological Sciences	*To serve through:*
Albert I. Lansing	1954
James A. Hamilton	1956
Clinical Medicine	
Robert A. Moore	1954
Joseph T. Freeman	1956
Psychological and Social Sciences	
Clark Tibbitts	1954
Wilma Donahue	1956
Social Work and Administration	
Georgia F. McCoy	1954
George Bugbee	1955

The past president, E. V. Cowdry, will also be a member of the Council for 1954.

All actions of the Council were confirmed.

It was suggested and approved that an opportunity

be given for Divisional Meetings during the Annual Meeting of the Society.

Dr. Morton Leeds suggested that the Gerontological Society form a Committee on Research to draw up plans and proposals for research programs on aging. The suggestion was referred to the Council for study.

The Society expressed appreciation to the Committee on Local Arrangements for their work in preparation for the Sixth Annual Meeting.

N. W. SHOCK
Secretary

REPORT OF THE COMMITTEE ON QUALIFICATIONS FOR FELLOWSHIP STATUS

Division of Biological Sciences

To be eligible for fellowship in the Division of Biological Sciences, the applicant shall possess the Ph.D. degree in any of the biologic sciences or the M.D. degree and shall have published the results of at least one original investigation. Fellowship will be conferred after nomination by two Fellows of this Division and affirmative vote of the Division of Biological Sciences at the annual meeting.

A. I. LANSING, *Chairman*
G. W. WAKERLIN
H. S. SIMMS

Division of Clinical Medicine

To be eligible for fellowship in the Division of Clinical Medicine, the applicant shall possess the M.D. degree from an approved medical school. Fellowship will be conferred after nomination by two Fellows of this Division.

J. M. STEELE, *Chairman*
E. L. BORTZ
J. E. KIRK

Division of Psychological and Social Science

IT is recommended that candidates for fellowship status shall meet the following qualifications:

a) That they hold a Ph.D. degree (or equivalent degree) in psychology or one of the social sciences from an institution of recognized standing.

b) That persons trained and working in personnel, business administration, education, and related fields be eligible for membership in the section.

c) That candidates hold full membership in a professional society in the major field of their activity (or be eligible for such membership).

d) That applicants have demonstrated interest in gerontology by practice, study, or research.

e) That the two Council Representatives of the section and a third person appointed by the President of the Gerontological Society shall constitute a committee to review all applications for fellowship status. This committee shall have the privilege of rejecting persons who meet all specified requirements for fellowship status, if it is satisfied that the applicants have been guilty of unprofessional conduct, or for any other valid reason. The committee also shall have the privilege of waiving the listed requirements in cases involving distinguished persons, and in appropriate instances may relax the requirement with regard to the Ph.D. degree. The relaxation of the Ph.D. degree shall be reserved for fields, such as education, where the degree is not usually required in order to attain full professional recognition.

f) They shall submit an application supported by the signatures of two Fellows of this Division.

O. J. KAPLAN, *Chairman*
E. W. BURGESS
WILMA DONAHUE

Division of Social Work and Administration

A Fellow in this Section shall be:

A) A person who is a member of one of the professional societies representing the social work profession, or who is eligible for membership, such person to have an interest in gerontology, demonstrated and supported by actual experience in the field within the three years preceding application for fellowship.

B) An administrator of a non-profit or governmental agency whose program falls in the field of gerontology and who himself meets the above qualification or whose agency is either eligible for membership in, or has been approved by, the official standard-setting agency in its particular field of service.

C) Administrators of commercially operated nursing or boarding homes or agencies who qualify for individual membership.

OLLIE A. RANDALL, *Chairman*
GEORGIA F. MCCOY
W. POSNER

REPORT OF THE COMMITTEE ON AFFILIATE ORGANIZATIONS

THE By-laws of the Gerontological Society provide that "Any non-profit corporation, association, or committee organized for purposes similar to those of the Society may become an affiliate of the Society, provided (a) that the officers of the Society . . . approve the certificate of organization . . . and (b) it shall agree to comply with a Charter of Affiliation. . ."

The By-laws provide further that there shall be a Division of Affiliate Organizations within the Society, which shall have one representative on the Council; that each affiliate organization shall pay annual dues at least equivalent to one subscription to the Journal; and that each affiliate organization may have one vote at meetings of the membership of the Society.

A Committee on Affiliate Organizations recommended that:

1. Applications for affiliation be received from State and local gerontologic societies, similar in objectives to the national organization; State and local public and voluntary non-profit groups organized for developing action programs; and national organizations having interests similar to those of the Society.
2. The Council of the Society would review applications on the basis of the by-laws or governing regulations of the applicant organization and would issue a revocable charter of affiliation.
3. Each affiliate would pay annual dues equivalent to one subscription to the Journal of Gerontology.

It should be noted that the Society's by-laws already provide for a Division of Affiliate Organizations with one representative on the Council; that each Affiliate Organization have one vote at regular meetings of the Society; and that members of Affiliates shall be affiliates, without dues or vote, in the national Society.

C. TIBBITTS, Chairman
W. ANDREW
WILMA DONAHUE
J. T. FREEMAN
H. E. JONES
R. A. MOORE
OLLIE A. RANDALL
A. J. TUTLES

BOOK REVIEWS

AGE AND ACHIEVEMENT, by H. C. Lehman, Princeton University Press, Princeton, 1953, 359 pages, $7.50.

Dr. Lehman's book on the relation between age and achievement in a wide variety of human endeavors is, in my opinion, the most significant publication in gerontology since Child's *Senescence and Rejuvenescence* in 1915. Presented in a remarkably factual manner, there is essentially no expression of subjective opinion, a rarity in publications on gerontology. The data are presented in tabular and graphic form and the questions arising from these data are itemized.

If we are to accept Lehman's data, and there is no apparent resason to doubt them, a number of disturbing points are raised. Maximum effectiveness in both quality and quantity exists, in all of the sciences and arts studied, at a very young age. With almost no variation this peak in performance occurs in the early thirties. Do we err, then, in thinking of senescent decline as a problem of later years, the fifties and sixties? We have here a possibility that aging from the point of view of decline begins very shortly after maturity.

Professor Lehman highlights a peculiar anomaly in our society; although peak effective performance occurs in the thirties and although retirement in many areas is mandatory at 65 or even less, administrative leadership, particularly in public life, is not attained until very late in life.

As should be expected of any good piece of work, this volume raises more questions than it answers. Should we accelerate educational programs so that the period of youthful effectiveness will be extended? Should we attempt to get younger men for the legislative and executive branches of government? Indeed, should we consider modification of our present policy of compulsory retirement at the usual age of 65? Perhaps it would be well to move young men to posts of maximum responsibility as rapidly as possible and to begin to downgrade them in responsibility at roughly 45. With advancing years the individual would be steadily moved to posts of less and less responsibility and total retirement could be obviated.

As a biologist, the reviewer is particularly impressed by the need for data on physical changes with age which can be correlated with these obvious performance changes. The data are specially needed to cover the age period of from 20 to 40 years of age.

A. I. LANSING
Department of Anatomy
Washington University
School of Medicine

LIVING WITH A DISABILITY, by Howard A. Rusk and Eugene J. Taylor, Blakiston Company, Inc., New York, 1953, 207 pages, $3.50.

This volume is largely an atlas of photographs and line drawings of adaptive devices for use of persons with various disabilities such as paraplegia of the transverse spinal cord type, various combinations of amputations, quadriplegia of both spastic and flaccid types, arthritic disabilities, and the like. The book seems to be an expansion of the project which the Institute of Physical Medicine and Rehabilitation of New York University has had going for several years and a collection cataloguing and disseminating ideas for such adaptations.

The material is grouped around ADL—Activities of Daily Living. A test sheet with various modifications has been worked out over a period of time which is divided into non-walking activities such as bed activities, toileting, eating, dressing and undressing, hand activities, wheelchair activities, and elevation activities. Then walking activities are subdivided into progressing, gait, climbing, and traveling. The rehabilitation center personnel first test the disabled individual and then use the information obtained concerning deficiencies, either to rule out the activity as a permanent impossibility or to utilize either an adaptive movement or an adaptive device such as a splint, brace, individually constructed tooth brush, comb, razor, spoon, and the like.

The chapter on kitchen activities for disabled housewives is of especial interest. Particularly ingenious are the adaptations which make possible one handed activities for hemiplegics with no recovery in the affected side and for one armed amputees or severe arthritics.

This volume should be available to all agencies dealing with the handicapped and of course to all rehabilitation centers. It is a basic work.

S. MEAD
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Washington University
School of Medicine

RECREATION FOR THE AGING, by Arthur Williams, Association Press, New York, 1953, 192 pages, $3.00.

This small volume was prepared by the author for The National Recreation Association as a practical planning guide for professional and volunteer leaders who are beginning or augmenting their recreation programs for older people. Virtually all of the first 13 chapters are concerned with the principles of such programs as they are derived from experience. These

principles, in summary, are the need for a broad range of activities based on the individual needs and interests of those who are being served; the need for broad community interest, cooperation, and interplay of services; the involvement of older people themselves in planning and conducting programs; the importance of continuing, competent, professional leadership supplemented by volunteer service; attractive, appropriate facilities; good public relations; and no membership restrictions except possibly a minimum age.

Chapter 14, the concluding chapter, covers a sample of local programs of various types and under a variety of auspices in order to demonstrate that "these principles are proven principles" and that they can be utilized as guides by those interested in sponsoring similar services.

It is the reviewer's opinion that Mr. Williams has fulfilled his purpose. Anyone searching for organizational and program suggestions concerning recreation for the aging cannot fail to find at least one or two interesting and constructive ideas in his book. Also helpful is a short but good bibliography covering general works in gerontology and geriatrics as well as key articles and books on recreation and aging.

M. L. BARRON
Department of Sociology and Anthropology
Cornell University

MAIMONIDES ON THE DURATION OF LIFE (Maimonides Ueber Die Lebens-Dauer. Ein unediertes Responsum) by Gotthold Weil, S. Karger, Basel, Switzerland, 1953, 59 pages, paper bound, $2.25. American representative, A. J. Phiebig, P. O. Box 352, White Plains, New York.

This scholarly essay takes us back some eight centuries to a question asked of the great physician and religious leader, Maimonides, by his student Joseph Ben Jehuda. Although the existence of the manuscript had been known since 1879, its exact location was a mystery when Dr. Weil became interested in it as a young man in 1902. Not until 1925 was he able to trace it to the Bodleian Library, whose director graciously supplied photographs. The shattering events of the succeeding years made completion of his study impossible but in no way stilled his enthusiasm. The present publication was completed in Jerusalem in October, 1950.

The question put to Maimonides was whether the duration of human life is unalterably predetermined, or whether man can lengthen his life by taking proper precautions. The answer is given in two forms in the original Hebrew, and in German translation. The text is then analyzed in relation to the teachings both of Islam and of earlier rabbinical authorities. Of interest to us is the fact that Maimonides discusses the question from the standpoint of the teachings of the Bible and from the viewpoint of the physician. He stresses the admonition in Deuteronomy (22.8) to place a railing around the roof of a new house to prevent accidents, and also considers at length Galen's views on the natural heat of the body, listing the various ways in which this may be diminished or lost through external and internal influences.

Dr. Weil's discussion of Maimonides' views in terms of the physiology and pathology of that period is particularly well done. His exposition of Avicenna's views is most instructive. He concludes that both these great physicians believed strongly in the efficacy of hygienic measures in prolonging life, and, at least as far as so-called natural death is concerned, were not too far away from present day thinking.

F. D. ZEMAN
New York, New York

DIABETIC NEUROPATHIES, by Joseph I. Goodman, Siegfried Baumoel, Leonard Frankel, Louis J. Marcus, and Sigmund Wassermann, American Lecture Series, No. 151, Charles C. Thomas, Springfield, Illinois, 1953, 138 pages, $4.75.

This little book is a report on 261 persons with diabetes mellitus of whom 161 (62 per cent) suffered with signs or symptoms which the authors believe signify neuropathy. They conclude that the pains in 22.2 per cent of the patients (usually in the legs, more often at night, often cramping and relieved by activity), the paresthesias (23.7 per cent), the evidences of autonomic nervous system dysfunction, the absent achilles reflex (25.6 per cent), and the occasional absence of patellar jerk indicate peripheral nerve involvment and are not of "vascular genesis." Objective sensory disturbance was present in only 4.2 per cent, and motor disturbance in 5.3 per cent of their cases, respectively.

To the gerontologist the special value of this book is in its reminder that pains, paresthesias, and the signs specified may point to unrecognized diabetes mellitus or inadequate control of this metabolic disorder. The clinical observations reported are certainly of general interest. However, despite its scholarly tone, the book seems to be an argument that "diabetic neuropathy" is a definite clinical entity and that the symptoms and signs indicate peripheral nerve damage or dysfunction. This point of view, vehemently maintained by the authors, is not substantiated by presentation of correlations of symptoms and signs in any sizeable group of their cases. Furthermore, the authors hold the opinion that every pain is in the final analysis a clinical expression of a dysfunction of sensation, and that pain is always an expression of disturbed function of a sensory nerve, with apparent disregard for the complexity of processes which

constitute the perception denoted by the blanket term "pain."

This faulty working concept is joined by confusion of correlation and etiology. Because the neurologic signs and symptoms are improved by control of the diabetes is no more a reason to ascribe the "neuropathy" to diabetes mellitus than there is now reason to ascribe "alcoholic neuropathy" to alcohol. Moreover, the authors seem disinclined to view "neuropathy" as a term of convenience which denotes a generalized neurologic disturbance of sensation or motor action in the pattern of peripheral nerve innervation, but with which cord, cerebral, or cerebellar disturbances occur.

Although even the most exacting observer might agree with the authors that a number of the patients may be clinically classified as suffering with neuropathy their report does not convincingly controvert the view, well phrased by Wechsler, that "contrary to general opinion, diabetic neuropathy is rare; diabetic pains are common."

It may yet be convincingly shown that diabetes mellitus is the most relevant etiologic factor in some cases of neuropathy, and the authors do alert the reader to the probability that neurologic signs in a diabetic may be correlated with that disorder; the latter is a significant contribution.

The observations of the authors are valuable, their review of publications dealing with this controversial subject is thorough and helpful, and their point of view provokes consideration of our definitions of disease and etiology.

A. I. GOLDFARB
New York, New York

RETIREMENT POLICIES AND THE RAILROAD RETIREMENT SYSTEM, Report No. 6; Part 1, Issues in Railroad Retirement, 770 pages, paper bound, $2.00; Part 2, Economic Problems of an Aging Population, 172 pages, paper bound, $.45; Reports of the Joint Committee on Railroad Retirement Legislation, U. S. Government Printing Office, Washington, D. C., 1953.

Part I, "Issues in Railroad Retirement," was said by Senator Paul Douglas, Chairman of the Joint Committee, to be "probably the most comprehensive single study of the Railroad Retirement System ever produced." It deals with (1) origin and growth of the System, (2) legislative developments, (3) comparison with other public and private pension plans, (4) financial problems, (5) eligibility and benefits, and (6) relationships to the Social Security System.

The Committee and its staff analyzed and compiled vast amounts of material and studied those prepared by our Governmental agencies. Materials were gathered also from hearings and staff conferences with other agencies.

Part II, "Economic Problems of an Aging Population," was intended to be a comprehensive fact book on the economic problems of an aging population, for use by Congress in conducting hearings and considering legislation affecting not only retired railroad workers but all workers. It discusses the growth of the older population since 1900, income and financial needs, employment, and retirement. An appendix of 62 pages contains a compilation and analysis of the most significant data available on problems of the aging, much of which is not easily available.

W. H. REALS
University College
Washington University

BOOKS RECEIVED

Books received since August 1, 1953, are acknowledged in the following list.

And Peace at the Last, by Russell L. Dicks and Thomas S. Kepler, Westminster Press, Philadelphia, 1953, 94 pages, $1.50.

Age and Achievement, by Harvey C. Lehman, Princeton University Press, Princeton, 1953, 358 pages, $7.50 (reviewed in this issue, page 87).

Effectiveness of Older Personnel in Retailing, by Robert L. Peterson, University of Illinois Bulletin, vol. 50, no. 67, 1953, 15 pages, paper bound, single copies free upon request to the University of Illinois, Urbana.

Films in the Cardiovascular Diseases. Survey, Analysis, and Conclusions, by David S. Ruhe, Adolf Nichtenhauser, Leo L. Leveridge, Henry J. Weintraub, and Morton M. Luger, American Heart Association, Inc., New York, 1953, 128 pages, paper cover $1.50, cloth cover $2.00.

Live Better After Fifty, by Ray Giles, McGraw-Hill Book Company, Inc., New York, 1953, 205 pages, $3.50.

Living with a Disability, by Howard A. Rusk and Eugene J. Taylor, Blakiston Company, Inc., New York, 1953, 207 pages, $3.50 (reviewed in this issue, page 87).

Nomenclature and Criteria for the Diagnosis of the Diseases of the Heart and Blood Vessels, by the Criteria Committee of the New York Heart Association, Inc., Harold E. B. Pardee, Chairman, New York, 1953, 360 pages, $4.95.

Older Adults in the Church, by Virginia Stafford, The Methodist Publishing House, Nashville, 1935, 35¢, paper bound.

Older People, by Robert J. Havighurst and Ruth Albrecht, Longmans, Green and Co., Inc., New York, 1953, 415 pages, $5.00.

Recreation for the Aging, by Arthur Williams, Association Press, New York, 1953, 192 pages, $3.00 (reviewed in this issue, page 87).

Rehabilitation of the Older Worker, edited by Wilma Donahue, James Rae, Jr., and Roger B. Berry, University of Michigan Press, Ann Arbor, 1953, 200 pages, $3.25.

Retirement Handbook, by Joseph C. Buckley, Harper & Brothers, New York, 1953, 329 pages, $3.95.

Retirement Policies and the Railroad Retirement System, Report No. 6; Part 1, Issues in Railroad Retirement, 770 pages, paper bound, $2.00; Part 2, Economic Problems of an Aging Population, 172 pages, paper bound, $.45; Reports of the Joint Committee on Railroad Retirement Legislation, U. S. Government Printing Office, Washington, D. C., 1953 (reviewed in this issue, page 89).

Study of Occupational Retirement. First Progress Report, conducted by the Department of Sociology and Anthropology, Cornell University, Ithaca, New York, 1953, 34 pages, mimeographed.

Vitamin Manual, Upjohn Company, Kalamazoo, Michigan, 1953, 90 pages.

INDEX TO CURRENT PERIODICAL LITERATURE

NATHAN W. SHOCK
Gerontology Section
National Heart Institute
National Institutes of Health

The subject categories are those in *A Classified Bibliography of Gerontology and Geriatrics* by Nathan W. Shock published by Stanford University Press, Stanford, California (1951). Only major headings are used and the Roman numerals correspond to those given in the bibliography. In so far as possible, references are classified according to organ systems. Thus most of the material on Geriatrics will be found under the organ system involved in the disease. Cross references are indicated by number at the end of each section. When available, abstract references are given *(B.A.—Biological Abstracts; P.A.—Psychological Abstracts;* and *P.I.—Population Index).* Abbreviations for journals are those used in *A World List of Scientific Periodicals Published in the years 1900-1933,* 2nd Edition. For journals not listed, abbreviations were devised according to the general rules used in the above source. It is impossible to cover all journals and list all papers concerned with aging and the aged. Authors and publishers are requested to call attention to publications or to send reprints to the Gerontology Section, Baltimore City Hospitals, Baltimore, Maryland. The assistance of the Forest Park Foundation, Peoria, Illinois, in the preparation of these materials is gratefully acknowledged.

GERONTOLOGY

10403. Bortz, E. L.: Making life longer and better; medical potentialities. *Geriatrics, 8:* 510-516, 1953.

10404. Desmond, T. C. (Chairman): *Enriching the years.* N. Y. State Joint Legis. Comm. on Problems of the Aging, Legis. Doc. No. 32, 1953, 199 pp.

10405. Gerontological Society, Inc.: Abstracts of scientific papers. (Sixth scientific meeting, 1953.) *J. Geront., 8:* 372-390, 1953.

10406. Greppi, E.: La Società di Gerontologia e i centri geriatrici in Italia. *Gior. Geront., 1:* 132-138, 1953.

10407. Havighurst, R. J.: *Human development and education.* Longmans, Green, N. Y., 1953, ix, 338 pp. Abstr: *P.A., 27:* No. 6438, 1953.

10408. Henschen, F.: Sopra l'essenza dell'invecchiamento. *Arch. De Vecchi, 18:* 693-704, Dec. 1952.

10409. Herzberg, F.: Training in the medical aspects of gerontology. *J. Geront., 8:* 493-494, 1953.

10410. Illinois. Public Aid Commission. Staff Development Services: *Studies in later maturity and the aged.* The Commission, Chicago, 1952, 53 pp. Abstr: *P. A., 27:* No. 5774, 1953.

10411. Introna, F.: Contributo allo studio diagnostico dell'età su resti di cadavere. *Minerva med.-leg., Torino, 72:* 139-144, 1952.

10412. Kaplan, O. J.: *Gerontology. In:* D. Brower, and L. E. Abt, *Progress in Clinical Psychology,* Grune & Stratton, N. Y., 1952, pp. 373-378. Abstr: *P.A., 27:* No. 6468, 1953.

10413. Krause, L.: Books on old age. *Maryland med. J., 2:* 254-255, 1953.

10414. Palmer, E. N.: Toward a sociological definition of old age; a research note. *Amer. J. Sociol., 59:* 28-29, 1953. Abstr: *P.I., 19:* No. 2222, 1953.

10415. Swift, K. L.: Effect of longevity on basic structures. *J. Mich. med. Soc., 52:* 499-505, 1953.

10416. United Nations. Population Division: Accuracy tests for census; age distributions tabulated in five-year and ten-year age groups. *Population Bull., —:* (2), 59-79, 1952. Abstr: P.I., *19:* No. 1663, 1953.

10417. Various (Symposium): La Gerontologia e Geriatria nei congressi; simposio internazionale sull'obesità essenziale; Sanremo-Aprile 1953. *Riv. Geront. Geriat., 3:* 129-136, 1953.

10418. Vettiger, G., A. Jaffé, and A. Vogt: *Alte Menschen im Altersheim; Soziologische, psychologische und medizinische Studien im Altersheim der Stadt Basel.* Benno Schwabe & Co., Basel, 1951, 150 pp.

10419. Anonymous: Convegno di Geriatria Sociale; III Congresso della Società Italiana di Gerontologia e Geriatria (Venezia 18-19 aprile 1953). *Gior. Geront., 1:* 129-131, 1953.

10420. Anonymous: Internationaler Kongress für Gerontologie und Geriatrie in Mailand vom 28. bis 30. März 1952. *Minerva med., Roma, 43:* 832, 1952.

10421. Anonymous: *Proceedings of the Second Institute on Aging.* Washington Univ., St. Louis, 1953, 58 pp. (Mimeogr.)

10422. Anonymous: VI° Congrès International de Pathologie comparée, Madrid 4 au 11 mai 1952.

Thème III. Les facteurs de sénéscence. *Path. gen., Paris, 52:* (643), 770-775, 1952.

See also No. 10764.

BIOLOGY OF AGING

IV. Longevity

(case reports, drugs, heredity, marriage, occupation, and sex differences)

10423. Brinton, H. P., E. S. Frazier, and A. L. Koven: Morbidity and mortality experience among chromate workers. *Publ. Hlth. Rep., Wash., 67:* 835-847, 1952. Abstr: *P. I., 19:* No. 1336, 1953.

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10425. Kaufman, G., and T. D. Woolsey: Sex differences in the trend of mortality from certain chronic diseases. *Publ. Hlth. Rep., Wash., 68:* 761-768, 1953.

10426. Kotsovsky, D. A.: Lebensdauer und Arbeit. *Naturw. Rdsch., 12:* 511, 1951.

10427. Kotsovsky, D.: Was wissen wir über die Lebensverlängerung? *Ärztl. Prax., Wien, 3:* 39, 1951.

10428. McKeown, T., and C. R. Lowe: Sex ratio of stillbirths related to birth weight. *Brit. J. soc. Med., 5:* 229-235, 1951. Abstr: *P.I., 19:* No. 1411, 1953.

10429. Meier, E.: Über neue Unterlagen, Berechnungen und Deutungen zur Übersterblichkeit der Knaben im Säuglingsalter. *Arch. Hyg., Berl., 135:* (3), 175-202, 1951.

10430. Metrop. Life Insur. Co.: Widowhood and its duration. *Statist. Bull. Metrop. Life Insur. Co., 34:* 1-3, Sept. 1953.

10431. Slatis, H. M.: Seasonal variation in the American live birth sex ratio. *Amer. J. hum. Genet., 5:* 21-33, 1953. Abstr: *P.I., 19:* No. 1757, 1953.

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IV-C. Longevity: *Comparative Physiology*

10433. Eddy, A. A.: Death rate of populations of *Bact. lactis aerogenes.* II. Environmental and other factors influencing the form of the survival curve. *Proc. roy. Soc. (Biol. Sci.), 141:* (902), 126-137, 1953.

10434. Eddy, A. A.: Death rate of populations of *Bact. lactis aerogenes.* III. Interpretation of survival curves. *Proc. roy. Soc. (Biol. Sci.), 141:* (902), 137-145, 1953.

10435. Eddy, A. A., and C. Hinshelwood: Death rate of populations of *Bact. lactis aerogenes.* I. Active adjustment of cells to adverse environments. *Proc. roy. Soc. (Biol. Sci.), 141:* (902), 118-126, 1953.

10436. Kvittingen, J.: Studies of the life-cycle of *Proteus Hauser.* III. *Acta path. microbiol. scand., 32:* 170-186, 1953.

10437. Sprent, J. F. A.: On the migratory behavior of the larvae of various Ascaris species in white mice. II. Longevity of encapsulated larvae and their resistance to freezing and putrefaction. *J. infect. Dis., 92:* 114-117, 1953.

See also Nos. 10524, 10579.

IV-H. Longevity: *Mortality Rates*

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10439. Clarke, R. D.: A bio-actuarial approach to forecasting rates of mortality. *Proc. Centenary Assemb., Inst. Actuar., 2:* 12-27, 1950. Abstr: *P.I., 19:* No. 2217, 1953.

10440. Collins, S. D., and J. Lehmann: *Excess deaths from chronic disease during influenza epidemics.* U. S. Govt. Print. Off., Wash., 1953. Monogr. No. 10, Publ. Hlth. Serv. Publ. No. 213. Abstr: *P.I., 19:* No. 1890, 1953.

10441. Doull, J. A., H. H. Gray, and H. Bancroft: A note on the recorded deaths from leprosy; continental United States, 1933-1948. *Int. J. Leprosy, 20:* 463-466, 1952.

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10446. Metrop. Life Insur. Co.: The continuing rise in longevity of the industrial population. *Statist. Bull. Metrop. Life Insur. Co., 34:* 4-6, Aug. 1953.

10447. Metrop. Life Insur. Co.: Shift in mortality to older ages. *Statist. Bull. Metrop. Life Insur. Co., 34:* 3-5, Sept. 1953.

10448. Metrop. Life Insur. Co.: The current diabetes problem. *Statist. Bull. Metrop. Life Insur. Co., 34:* 5-7, Sept. 1953.

10449. Ødegård, Ø.: The excess mortality of the insane. *Acta psychiat. neur. scand., 27:* (3-4), 353-367, 1952.

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10451. Rees, W. S.: Fatal appendicitis; the decline in mortality. *Lancet, 2:* (6747), 1199-1203, 1952. Abstr: *P.I., 19:* No. 1904, 1953.

10452. Söderlund, B. A.: (An attempted comparison of total cancer mortality in the male and female in Finland and certain other European countries.) *Suom. lääk. lehti, 8:* 104-108, 1953.

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